1986 Annual Report

# The Manitoba Cancer Treatment and Research Foundation

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## Annual Report for the Year 1986

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**1986 ANNUAL REPORT**

Edited by: J. Singer, Manitoba Cancer Foundation,
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W. L. Milne, Esq.,
Chairman
The Manitoba Cancer Treatment
and Research Foundation

Sir:

It is my pleasure to submit to you the Annual Report of the Manitoba Cancer Treatment and Research Foundation. The body of the report documents the activities of patient care, support services, educational programs and research for 1986. We submit as a supplement to the body of the report the Cancer Incidence and Mortality Statistics for the Province for that year.

Again the staff of the Foundation have expended a major effort to upgrade out-patient services, radiotherapyy facilities and the provision of dedicated oncology beds and in-patient services. As of the close of 1986 none of these issues has been resolved. We do however have some indication that dedicated oncology beds will be provided for oncology patients at both Health Sciences Centre and at St. Boniface Hospital within the next 12 to 18 months. We also have some reason to hope that the radiotherapy equipment requests may be granted in the coming year which do however delay the installation of that equipment into 1988.

Again it is my sincere pleasure to acknowledge the support of the staff whose dedication makes possible the work and the purpose of the Foundation.

Respectfully submitted,

L. G. Israels, M.D.
Executive Director

# THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## BOARD OF DIRECTORS

W. L. Milne, *Chairman*

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## ADVISORY MEDICAL BOARD

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P. A. Galbraith, M.Sc., M.D., F.R.C.P. (C), F.A.C.P.
G. V. Krepart, B.Sc., M.D., F.R.C.S. (C), B.C.A.M. (Ob/Gyn), F.G.O., S.B.C.G.O.
J. P. Maclean, M.D., F.R.C.P. (C), Retired Sept. 17, 1986
I. C. Peever, M.D., F.R.C.S. (C)
E. W. Ramsey, M.D., F.R.C.S., (Ed.), F.R.C.S. (C), Retired Sept. 17, 1986
S. Shalev, Ph.D., Retired Sept. 17, 1986
B. H. Weinerman, M.D., F.R.C.P. (C)

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V. E. Nelson
J. Wade

## ADMINISTRATION

**Executive Director** — L. G. Israels, M.D.
**Assistant Executive Director** — R. R. Publow
**Executive Secretary** — J. Singer
**Administrative Assistant Finance** — I. Birse
**Administrative Assistant Personnel** — J. Morton
**Accounts Payable** — M. Nash

## PROFESSIONAL STAFF

The Foundation is an integral part of the teaching and research program of the University of Manitoba. Various staff members participate in the undergraduate oncology program, teach on the hospital wards, and have graduate students in their laboratories.

UNIVERSITY APPOINTMENTS

**Faculty of Medicine**

- Department of Anatomy
  - Dr. G. Froese, *Associate Professor*
- Department of Biochemistry
  - Dr. J. Wright, *Professor*
  - Dr. L. G. Israels, *Adjunct Professor*
- Department of Immunology
  - Dr. F. Paraskevas, *Professor*
  - Dr. A. Greenberg, *Associate Professor*
  - Dr. D. A. Chow, *Assistant Professor*
- Department of Internal Medicine
  - Dr. L. G. Israels, *Distinguished Professor*
  - Dr. G. J. Goldenberg, *Professor*
  - Dr. F. Paraskevas, *Professor*
  - Dr. E. Baral, *Associate Professor*
  - Dr. L. Brandes, *Associate Professor*
  - Dr. D. Bowman, *Associate Professor*
  - Dr. M. Levitt, *Associate Professor*
  - Dr. B. Schacter, *Associate Professor*
  - Dr. H. Schipper, *Associate Professor*
  - Dr. B. Weinerman, *Associate Professor*
  - Dr. A. Begleiter, *Assistant Professor*
  - Dr. E. Bow, *Assistant Professor*
  - Dr. J. Johnston, *Assistant Professor*
  - Dr. H. Y. P. Lam, *Assistant Professor*
  - Dr. S. T. Lee, *Assistant Professor*
  - Dr. J. Wright, *Adjunct Professor*
- Department of Microbiology
  - Dr. J. Wright, *Professor*
- Department of Obstetrics and Gynaecology
  - Dr. G. V. Krepart, *Associate Professor*
  - Dr. R. J. Lotocki, *Assistant Professor*

Department of Pediatrics
- Dr. A. Bishop, *Professor*
- Dr. A. H. Greenberg, *Associate Professor*
- Dr. J. M. Gerrard, *Associate Professor*
- Dr. E. D. Israels, *Associate Professor*
- Dr. M. Schroeder, *Associate Professor*
- Dr. S. J. Israels, *Assistant Professor*
- Dr. N. Kobrinsky, *Assistant Professor*

Department of Physiology
- Dr. J. Dodd, *Assistant Professor*
- Dr. M. Mowatt, *Assistant Professor*

Department of Radiology
- Dr. E. Baral, *Associate Professor*
- Dr. J. M. Gillies, *Associate Professor*
- Dr. K. Malaker, *Associate Professor*
- Dr. S. Shalev, *Associate Professor*
- Dr. P. Dunscombe, *Assistant Professor*
- Dr. G. Froese, *Assistant Professor*
- Dr. P. Hahn, *Assistant Professor*
- Dr. D. I. Hodson, *Assistant Professor*
- Dr. W. Huda, *Assistant Professor*
- Dr. K. D. Jones, *Assistant Professor*
- Dr. W. McLellan, *Assistant Professor*
- Dr. A. L. Meikle, *Assistant Professor*
- Dr. R. F. Palser, *Assistant Professor*
- Dr. A. Sourkes, *Assistant Professor*
- Dr. E. Hadzic, *Lecturer*
- Dr. T. Lee, *Lecturer*

Department of Surgery
- Dr. E. Ramsey, *Professor*
- Dr. B. J. Anderson, *Assistant Professor*
- Dr. W. Beecroft, *Assistant Professor*

Department of Social and Preventative Medicine
- Dr. N. W. Choi, *Professor*
- Dr. N. A. Nelson, *Associate Professor*
- Mrs. P. F. Moodie, *Lecturer*

**Faculty of Science**

Department of Physics
- Dr. P. Dunscombe,*Adjunct Professor*
- Dr. G. Froese, *Adjunct Professor*
- Dr. W. Huda, *Adjunct Professor*
- Dr. L. Lee, *Adjunct Professor*
- Dr. R. Palser, *Adjunct Professor*
- Dr. S. Shalev, *Adjunct Professor*

Computer Science
- Dr. M. Laucht, *Associate Professor*

## SCIENTIFIC ADVISORY COMMITTEE

H. Duckworth, B.Sc., Ph.D.
Professor, Dept. of Chemistry
University of Manitoba

A. Froese, B.Sc., Ph.D.
Professor, Dept. of Immunology
University of Manitoba

F. Labella, B.A., M.A., Ph.D.
Professor, Dept. of Pharmacology and Therapeutics
University of Manitoba

## RADIATION ONCOLOGY

**Director** — K. Malaker, M.D., Ph.D.

### M. R. MacCHARLES UNIT:

E. Baral, M.D., Ph.D.
J. M. Gillies, L.R.C.P.&S.(E), F.R.C.P.(C), F.A.C.R.
E. Hadzic, M.D., F.R.C.P.(C)
P. Hahn, M.D., Ph.D.
D. I. Hodson, M.A., B.M., B.Ch., F.R.C.P.(C)
K. D. Jones, M.B., B.Ch., C.F.C.S.(Eng.), F.R.C.R.
W. McLellan, M.B., Ch.B., D.M.R.T., F.R.C.P.(C)
A. L. Meikle, M.B., Ch.B., D.M.R.T.(Ed.), F.R.C.P.(C)

**Residents**

A. Bains, M.D., P. A. Blood, M.B., B.S., B.Sc., V. Sharma, M.B., B.S. (Rotating Intern), K. Vijayaraghavan, M.B., B.S., G. Wong, M.B., B.S.

**Radiobiology**

S. Biswas, Ph.D. — Research Associate
R. M. Das, B.Sc., Ph.D.

**Support Staff**

S. Burgess, C. Campbell, J. Demeulemeester

**Orderlies:**

J. Pelletier, D. Perreta, R. Villabrille

### ST. BONIFACE GENERAL HOSPITAL UNIT

**Support Staff**

S. Booth, K. Friesen, S. Johnson, C. MacLean, J. Redden, L. Soshycki, A. Werbicki

## THERAPY EQUIPMENT

**M. R. MacCharles Unit:**

Therac 40/Sagittaire linear accelerator
4 MV S.H.M. linear accelerator
A.E.C.L. Model F Cobalt 60 beam therapy unit
250 kV x-ray therapy unit
140 kV x-ray therapy unit
Picker simulator
A.E.C.L. Therasim 750 simulator
A.E.C.L. Theraplan treatment planning computer
TAGMED 2450 $MH_Z$ hyperthermia unit

**St. Boniface General Hospital:**

100 kV superficial x-ray therapy unit
A.E.C.L. Theratron 780 Cobalt unit

## EXTERNAL IRRADIATION

At the M. R. MacCharles Unit, 1,172 new patients were treated and 712 patients were re-treated.

At the St. Boniface Unit, 387 new patients were treated and 238 patients were re-treated.

| | M.R.M. Unit. | S.B. Unit | Total |
|---|---|---|---|
| Patient Visits | 18,740 | 3,493 | **22,233** |
| Treatments | 23,539 | 6,112 | **29,651** |

## NUMBER OF TREATMENTS WITH RADIOACTIVE SOURCES

| Cesium 137 | Iridium 192 | Beta Applicator | Total |
|---|---|---|---|
| 96 | 13 | 17 | 126 |

## INTRODUCTION

The Radiation Oncology services for the province of Manitoba are based at the Manitoba Cancer Foundation, 100 Olivia Street, to which the majority of patients are referred and the major service facilities are also located. To a lesser extent, Radiotherapy service is also provided at the St. Boniface Hospital Oncology Unit, where an isocentric tele-cobalt unit and a simulator are in place. This was thought to be adequate until recently when there has been an increase in the utilization of radiotherapy machine time resulting in several weeks of waiting for our patients who require treatment, particularly on the high energy linear accelerator. Because of the increased need a second high energy linear accelerator is now in the process of purchase. The 14 year old 4 MeV linear accelerator which is located at the Manitoba Cancer Foundation is also being replaced.

Due to the increase in the work load in radiotherapy and the increasing waiting list, the working hours for the high energy linear accelerator have been extended to 7:30 a.m. — 10:00 p.m. During the extended working hours, radiation oncologists are also present on the premises to offer coverage. I would personally like to extend my sincere thanks and gratitude to the technologists, physicists, and the Radiation Oncology staff and residents who have been extremely cooperative during this critical period. The Radiotherapy staff members continue to rotate through the St. Boniface Oncology Unit to provide radiotherapy services. With the changing pattern of practice, it is anticipated that we will establish a stronger base at the St. Boniface Unit.

In addition, members of the professional staff continue to attend Tumor Rounds at the Victoria General Hospital and Misericordia Hospital. At the Foundation, a Head and Neck multidisciplinary clinic takes place weekly and is reported in detail elsewhere. Multidisciplinary consultation clinics for breast and gastrointestinal neoplasms have also been introduced. Because of the increasing number of Surgical Oncology referrals, the number of surgical clinics has increased. Recently, the Foundation acquired a fibreoptic gastroscope. With the increasing number of endoscopy and minor surgical procedures, the operating suite is now in frequent use.

The Radiotherapy staff maintains a very close liaison with Gynecological Oncology. Gynecological insertion of cesium is still confined to the Health Sciences Centre and an increasing number of interstitial implants are also carried out at the Health Sciences Centre.

There has been a further increase in the various academic activities within and outside the department. The department is now actively involved in undergraduate training. The Residency Training Program continues to thrive. We offer a four year Residency Training Program in Radiation Oncology which is approved by the Royal College of Physicians and Surgeons of Canada and was given a full five year accreditation this year by the reviewers from the Royal College of Physicians. The training program is also recognized by the American College of Radiology and the Royal College of Radiology of the United Kingdom. The department also offers a two year training program in Radiotherapy Technology and this program continues to attract a very large number of well qualified applicants.

## STAFFING

Dr. Ian Hodson, resigned to join the Hamilton Cancer Clinic in Ontario as a senior Radiation Oncologist. Dr. Jim Gillies, who served as Director of Radiation Oncology for 13 years, retired at the end of 1986. Dr. Alex Meikle continues to work as a full time staff man, post-retirement, and we appreciate his contribution immensely.

Dr. Edward Baral, from the Radiumhemmet Institute of Karolinska Hospital in Stockholm, joined the Radiation Oncology Department in September 1986.

Dr. Keith Jones joined the Department in July 1986 as a staff member, having trained in Oxford and at the Christie Hospital and Holt Radium Institute in Manchester, England.

## BRACHYTHERAPY BEDS

The brachytherapy beds were relocated from the D2 ward of the HSC General Centre to B6 in two rooms with two lead shielded beds. We are experiencing longer waiting lists for both gynecological brachytherapy and non-gynecological implantation treatments. Discussions are in progress with the Health Sciences Centre to increase the number of brachytherapy beds. Discussions are under way to start brain implants for high grade brain tumors at the St. Boniface Hospital. There are two neurosurgeons who will participate in the program. A stereotactic biopsy unit, which will also be used for radioactive seed placement is available at St. Boniface Hospital. Hopefully, this therapy will begin in 1987.

## ACADEMIC ACTIVITIES

1. *Radiation Oncology Clinical Conference:* staff and residents of the department discuss management of new referrals and problems arising in ongoing patients.
2. *Radiotherapy and Radiology Seminars:* CT scans for diagnosis and Radiotherapy treatment plans are discussed in detail with Drs. W. Gordon and H. Greenberg of the Department of Radiology.
3. *Radiotherapy Treatment Planning Seminars:* are held monthly where a retrospective survey of site oriented treatment plans is carried out, as well as discussions of newer techniques developed by the members of the Departments of Physics and Radiation Oncology.

4. *Monthly Lecture Sessions:* once each month members of the department, or invited guests from other faculties, present topics of current medical or oncological interest.
5. *Residency Training Program:* This year the Residency Training Program received five full years of full accreditation by the auditors of the Royal College of Physicians of Canada. Currently there are five trainees in the program. Dr. K. Vijay, is currently a fellow and is rotating through the Princess Margaret Hospital in Toronto and the Radiotherapy Department of the University of Minnesota in Minneapolis to obtain further training in Pediatric Oncology. Dr. A. Bains has completed his year of medical rotation and returned to the Radiation Oncology Department. Dr. G. Wong rotates through Gynecological Oncology and the Princess Margaret Hospital. Dr. Paul Blood joined our program as a first year resident and is currently doing a year of Internal Medicine rotation.
6. Ph.D. Program: P. Samadder has been accepted to commence her post-graduate training program in Radiation Genetics, in conjunction with the Department of Genetics. The funding has been approved for five years by the Ministry of Education, Government of India.

### POSTGRADUATE TEACHING

Dr. Malaker, Dr. Hodson and Dr. Gillies presented a series of seminars on the Principles and Practices of Radiotherapeutics to the residents from Surgery, Gynecology, and Chest Medicine.

### UNDERGRADUATE TEACHING

1. *Second Year Medical/Clinical Teaching* — This year we continued to teach second year medical students clinical skills between January and May. Twenty-nine second year medical students rotated through the department as part of their clinical skills program.
2. *Fourth Year Medical Elective Program* — Ten 4th year medical students rotated through Radiation Oncology as a part of their Radiology rotation. Drs. Ian Hudson, P. Dunscombe and K. Malaker presented seminars on Radiation Biology, Physics and Pathology.
3. *Fourth Year Basic Science Seminars* — Dr. K. Malaker and Dr. W. Huda of the Department of Physics jointly delivered a series of lectures to groups of 4th year medical students on the Aspects of Radiation Biology, Pathology, Risks and Radiation Protection.

## CLINICAL RESEARCH

### HYPERTHERMIA

*Dr. K. Malaker, Dr. P. Dunscombe and Dr. G. Froese*

The hyperthermia team continues to accept the patients with superficial tumors on low dose radiation with hyperthermia. Schedules have now changed from five times to twice weekly hyperthermia, which is given after radiation, using Tagmed 2250 MHz microwave system for superficial tumors not deeper than 3 cm. from the skin surface and surface extension less than 6 cm. in diameter. This phase I trial will continue.

## SUPERFRACTIONATED AND MULTIPLE DAILY FRACTIONATED RATIOTHERAPY

*Dr. K. Malaker, Dr. D. I. Hodson, Dr. A. L. Meikle, Dr. W. McLellan, Dr. J. M. Gillies*

Superfractionated radiation research in the clinical setting continues to accrue patients in several sites.

### ADVANCED HEAD AND NECK CANCER

*Dr. K. Malaker, Dr. K. Jones, and Dr. W. McLellan*

Advanced head and neck cancer patients have been treated with twice daily fractionation at a rate of 180 rads per fraction with each fraction given at 5-6 hour intervals and a total dose up to 5400 rads. The tolerance is satisfactory and seems to be superior to three times daily fractions and tumor control also seems to be comparable, if not slightly better. An analysis will be carried out shortly after we have accumulated enough cases in this study.

### CARCINOMA OF THE PANCREAS

*Dr. K. Malaker, Dr. W. McLellan*

Superfractionated treatment for pancreatic cancer is continuing. The patients are receiving 160 rads per fraction with fractions given at 5-6 hour intervals to a total dose of 4800-5400 rads. The acute tolerance and immediate control rate seem to be satisfactory. The palliative value of this regimen again seems to be superior to that of standard radiation treatment. Long term control and delayed reaction for this site are currently being evaluated.

### CARCINOMA OF THE ESOPHAGUS

*Dr. K. Malaker, Dr. W. McLellan*

Inoperable, localized esophageal carcinoma is being treated with a multiple fractionated schedule. The time/dose fractionation is 180 rads per fraction, two treatments per day at 5-6 hour intervals to a total dose of 5250 rads. The short term response and tolerance seem to be satisfactory. The accrual for this pilot project is rather slow because of the low incidence and low referral but, in view of the satisfactory palliative effect and high patient compliance, the trial will continue.

### RADICAL COMBINED SURGERY/RADIOTHERAPY SANDWICH TECHNIQUE FOR OPERABLE Ca ESOPHAGUS

*Dr. K. Malaker, Dr. A. L. Meikle, Dr. D. I. Hodson*

We continue to accrue patients slowly in this pilot study. This technique uses pre-operative 600 rads single dose radiotherapy to the esophagus to be followed by esophagectomy within 24 hours of radiation. This is to reduce operative metastasis and slow the rate of residual tumor cell regrowth in the mediastinum. After 2-4 weeks of convalescence, providing pathological staging remains unaltered, post-operative radiation is given to the mediastinum to a total dose of 4000 rads in 15 treatments, 800 rads to the upper abdomen, paraceliac and hepatic regions, and 700-750 rads to both paraclavicular areas, both in single fractions. There have been no serious complications from this regimen and the two year survival seems to be considerably superior to other standard treatments, either with radical surgery with or without radiation, or radical radiation alone.

### RADIOPROTECTIVE EFFECT OF SUPEROXIDE DISMUTASE

*Dr. K. Malaker, Dr. D. I. Hodson, Dr. v. Taraska*

The radioprotective effect of copper zinc superoxide dismutase named WinSOD, which will be supplied by the Rh Institute of Manitoba, will be tested on patients with carcinoma of the lung who have been accepted for radical treatment. The Phase I pilot study protocol has been developed and application has been made for Ethics approval, following which the study will start, hopefully in the beginning of the new year.

### THE INVESTIGATION OF DELAYED RADIATION REACTION

*Dr. K. Malaker*

We are continuing to accrue, register and document all the patients with significant delayed radiation reactions, i.e., neuropathy, fibrosis, nephritis, etc. On satisfactory accrual in this series, following analysis, it is hoped that the findings will lead to the investigation of genetic response to radiation reaction.

### RADIOTHERAPY OF CANCER OF PROSTATE — COMPARISON OF CT SCAN VS CONVENTIONAL PLAN

*Dr. P. Hahn, Dr. K. Malaker, Dr. A. L. Meikle, Dr. K. D. Jones, Dr. S. Shalev, Dr. N. Nelson, P. Moody*

Clinical investigation has been initiated to evaluate the difference in acute and delayed reaction and tumor control in groups of stage B and C cancer of prostate patients treated radically for cure, planned either with the help of CT scan or by standard radiological technique. This study is in progress and accrual is satisfactory.

### Laboratory Investigations:

Dr. R. M. Das, Dr. K. Malaker and Dr. G. Froese continue to work on the radiobiology of multiple fraction radiation, the radioprotective effect of superoxide dismutase and normal tissue reaction to hyperthermia with and without radiation in the animal system. Preliminary findings have also been reported at the Radiation Society meeting in Las Vegas and at the 49th annual general meeting of the Canadian Association of Radiologists in Halifax in June 1986. Dr. S. Shalev, along with Dr. K. Malaker, has continued to study the detailed enhancement of port films. This study has recently been completed and the data is being analyzed for final evaluation.

### OTHER CLINICAL ACTIVITY

The Radiation Oncology Department continues to participate in various national and international clinical research programs which include NCI(C), NSABP, ECOG, CCOG, etc. A list of various active protocols which have been carried out in conjunction with the Department of Radiotherapy follows:

| | |
|---|---|
| **NCIC 0V.7** | **Clinical trial comparing abdominal-pelvic radiation versus cyclophosphaide + cisplatin chemotherapy in patients with epithelial ovarian carcinoma having only microscopic residual disease following surgery.** |

| | |
|---|---|
| 0V.8 | Clinical trial examining the treatment of patients with macroscopic residual epithelial ovarian carcinoma. |
| BR.6 | A clinical trial for early versus late radiotherapy for treatment of limited small cell carcinoma of the lung. |
| MBR 86.1 | A randomized study to compare the toxicity and effectiveness of radiotherapy plus Lonidamine with "standard" radiotherapy itself in patients with inoperable non-small-cell lung cancers without distant metastases. |
| NSABP R-01 | To compare no treatment versus combination chemotherapy versus radiotherapy in patients with Duke's B or C rectal carcinoma after surgery. |
| B-17 | A clinical trial to evaluate natural history and treatment of patients with non-invasive intraductal adenocarcinoma. |
| M.H.&N. 82.1 | To compare radiotherapy versus radiotherapy plus combination chemotherapy in patients with advanced carcinoma of larynx or hypopharynx without distant metastases. |

**Pediatric**

| | |
|---|---|
| | National Wilms Tumor Study III |
| CCSG-123 | Lymphoma Leukemia |
| CCSG-502 | Disseminated Lymphocytic Lymphoma |
| CCSG-631 | Rhabdomyosarcoma |
| CCSG-321 | Neuroblastoma |

## HEAD AND NECK TUMOR CONFERENCE AND CLINIC

*Dr. D. I. Hodson — Co-ordinator — to 31 August 1986*

*Dr. K. D. Jones and Dr. W. A. Beecroft — Joint Coordinators — from 1 September 1986*

The weekly Head and Neck Clinic, which was established in 1971, continued through 1986 each Thursday morning, attended by staff members from the Manitoba Cancer Treatment and Research Foundation and the Health Sciences Centre, with a special interest and expertise in head and neck oncology. Walk-rounds are held and in-patient problems reviewed, following which the formal conference begins. The relevant pathology and radiology is then reviewed, following which discussion takes place aimed at producing a consensus in a multidisciplinary setting, for the optimum management of each patient. The follow-up clinic is held following this Conference. Here, both previously treated patients and patients undergoing treatment are reviewed, again in a multidisciplinary fashion, allowing the treatment results and complications of all modalities to be evaluated.

The Conference and Clinic continue to be busy with 144 patients being presented at the formal Conference and a total of 1,615 patient visits being recorded in the follow-up clinic during 1986. Once more this represents an increase over the previous year. We would like to thank the nursing and administrative staff for their help in organizing this weekly undertaking.

The formal Conference presentations continue to be chaired in rotation by representatives of the Radiation Oncology and Surgical sections. We would like to thank Dr. MacEwan and Dr. Alguacil for their invaluable help with the Radiology and Pathology portions at the Conference, and also to welcome Dr. Keith Jones of the Department of Surgical Oncology and Dr. Wayne Beecroft of the Department of Surgical Oncology to act as joint coordinators of the Head and Neck Clinic, on the resignation of Dr. Ian Hodson.

Unfortunately, the patients with advanced non-resectable disease continue to form a substantial proportion of patients seen and we are continuing to participate with the Princess Margaret Hospital in Toronto in the prospective evaluation of the addition of chemotherapy (5 Fluorouracil and Mitomycin-C) to radiotherapy for these patients. This study, has now been concluded and is ready for final analysis. The Head and Neck Clinic is also active in the prospective local investigation of the use of multiple daily fractionated radiation and hyperthermia in advanced head and neck cancer patients. A pilot study also has been initiated by this group to evaluate the effect of Beta-carotene and/or retinoids in upper aero-digestive mucosal hysplasia.

## PUBLICATIONS

P. B. Dunscombe, J. McLellan and K. Malaker: Heat production in microwave thermocouples. Medical Physics, Vol. 13, No. 4, July/August 1986.

## ABSTRACTS

Thermometry of the Spinal Cord in Experimental Hyperthermia in Mice. Presented at the 34 Annual Meeting, Radiation Research Society in Las Vegas, Nevada, April 1986: G. Froese, P. D. Dunscombe, K. Malaker and R. M. Das.

Heat Production in Microwave Irradiated Thermocouples. Presented at the 34th Annual Meeting, Radiation Research Society in Las Vegas, Nevada, April 1986: P. B. Dunscombe, J. McLellan and K. Malaker.

Pertubation of the Temperature Distribution in Microwave Irradiated Tissue due to the Presence of Metallic Thermometers. Presented at the 34th Annual Meeting, Radiation Research Society in Las Vegas, Nevada, April 1986: R. T. Constable, P. B. Dunscombe, A. Tsoukatos, K. Malaker.

Experimental Study of Rat Lung Response to Varying Radiation Fractionation. Presented at the Canadian Association of Radiologists Meeting in Halifax, Nova Scotia in June 1986: K. Malaker and R. M. Das.

Comparison of the Results of Two Pilot Studies using Multiple Daily Fractionated Radiation for Carcinoma of the Pancreas. Presented at the Canadian Association of Radiologists Meeting in Halifax in June 1986: K. Malaker.

Mesothelioma: the Manitoba Experience. Presented at the Canadian Association of Radiologists Meeting in Halifax in June 1986: D. I Hodson, P. D. Dunscombe, M. Soubra, G. Wong, K. Malaker.

Comparison of Treatment Planning Techniques for External Beam Irradiation of the Prostate using Score Functions. Presented at American Society of Therapeutic Radiation Oncologists at Los Angeles in November 1986: P. Hahn, L. Bartel, P. Therrien, S. Shalev, M. Carey.

# SURGICAL ONCOLOGY

**SECTION MEMBERS:**

W. A. Beecroft, D.D.S., M.D., F.R.C.S.(C), F.A.C.S.;
B. J. Anderson, M.D., F.R.C.S.(C)

**RESIDENTS:**

Michael Jessen, M.D., John Spielman, M.D., Mario Jarmuske, M.D., Brenda Levin, M.D., Kiu-Sing Cheng, M.D., Lindsay DuVal, M.D., Don MacNaughton, M.D., Al-Ghamdi, M.D., Ian Huang, M.D.

**NURSING STAFF:**

J. Kostenuik, R. N., L. Scott, R.N., S. Kelly, L.P.N.

## SECTION OF SURGICAL ONCOLOGY

### ORGANIZATION

The Section of Surgical Oncology now provides daily consultative services and clinics five days a week at The Manitoba Cancer Treatment and Research Foundation. Active involvement in the Head and Neck Tumor Conference and Clinics continues. Biopsy and endoscopy services are provided. Sigmoidoscopy, nasendoscopy and fiberoptic laryngoscopy capability for patient evaluation and follow-up at the Foundation is available.

Frequent multidisciplinary consultations with Radiation Oncology and Medical Oncology are carried out. Surgical procedures, both diagnostic and therapeutic are carried out at the Health Sciences Centre as part of the Surgical Oncology Service function in the Section of General Surgery.

### TEACHING

The resident and undergraduate house staff for the Surgical Oncology Service at the Health Sciences Centre participate in the Head and Neck Tumor Conference and Clinic as well as the other Surgical Oncology Clinics. Each year two General Surgical Residents as well as two junior Otolaryngology Residents participate in the clinics as part of their postgraduate surgical training program.

Other residents rotate through the service from Oral Surgery, Radiation Oncology, and Medical Oncology from time to time. These clinics provide experience in new patient evaluation, multi-disciplinary consultation, and patient follow-up in a wide variety of malignant diseases.

### CLINICAL INVESTIGATION

Active participation in the numerous N.S.A.B.P. Breast Carcinoma Trials and Colo-Rectal Trials is promoted. N.C.I.C. Melanoma Trial is ongoing. The pilot study looking at advanced laryngeal, or hypopharyngeal carcinomas treated with radiation versus radiation plus chemotherapy has closed. The preliminary results will hopefully be available in the near future. A review of the management of laryngeal carcinoma in the Province of Manitoba has been carried out, and the results presented at the Canadian Otolaryngology Association Meeting.

Continued interest in developing further Head and Neck Oncology protocols as well as other protocols for the management of malignant disease are prompted.

## SECTION OF SURGICAL ONCOLOGY STATISTICS

### Manitoba Cancer Treatment and Research Foundation

| | New Patients | Follow-up Visits | Total Patient Visits |
|---|---|---|---|
| 1983 | 217 | 784 | 1,001 |
| 1984 | 287 | 1,225 | 1,512 |
| 1985 | 417 | 1,660 | 2,077 |
| 1986 | 477 | 2,113 | 2,590 |

### Diagnostic Outpatient Procedures

| | Endoscopy | Biopsy | Total |
|---|---|---|---|
| 1983 | | | 152 |
| 1984 | 11 | 182 | 193 |
| 1985 | 36 | 247 | 283 |
| 1986 | 58 | 270 | 328 |

## PRESENTATIONS

"Breast Disease Overview", Selkirk, Manitoba, May, 1986, W. A. Beecroft.

"Airway Access Using Cricothyroidostomy", Canadian Association of Clinical Surgeons, Western Division Meeting, Winnipeg, Manitoba, March, 1986, W. A. Beecroft.

"Surgical Management of the Difficult Airway", Canadian Anaesthetists Society, Western Division Meeting, Banff, Alberta, May, 1986, W. A. Beecroft.

"Carcinoma of the Larynx, The Manitoba Experience", Canadian Otolaryngology Society Meeting, June, 1986, J. Dort presenting.

"The Use of Adjuvant Therapy in Management of Well Differentiated Thyroid Cancer", C.A.G.S. Head and Neck Surgery Course, The Royal College of Physicians and Surgeons Meeting, Toronto, Ontario, September, 1986, W. A. Beecroft.

# ONCOLOGY NURSING/TECHNOLOGY

**Director of Nursing:** B. Glenday, R.N., R.T.T.
**Assistant Director of Nursing and Clinical Investigation Liaison Nurse:** J. Lutz, R.N.

## MEDICAL ONCOLOGY:

N. Johnson, R.N., Senior Nurse
S. Bracken, R.N., L. Friesen, R.N., D. Rumpel, R.N., S. Switzer, R.N.

**Clinical Assistants:**
I. DeSousa, G. Harney, L. Jonasson, U. Merck

**Clinical Investigation:**
K. McDonald, R.N., Senior; V. Powell, R.N.

**Gynecological Oncology:**
I. Chrunyk, R.N.

**Pediatric Oncology:**
P. Pruden, R.N.

## RADIATION ONCOLOGY:

M. Chambers, R.N., Senior Nurse
B. Dodds, R.N., S. Kelly, L.P.N., J. Kirbyson, R.N., R.T.T., E. Nelson, R.N., L. Scott, R.N.

**Clinical Assistant:**
I. Turnbull

**Unit Assistant:**
M. Corden

**Surgical Oncology:**
J. Kostenuik, R.N.

**Radiotherapy Technologist Training Program Coordinator:**
E. Kirk, R.N., A.C.(T)

**Radiotherapy Technologists:**
Supervisor — J. Wood, R.T.T.
Senior Technologists — K. Fox, R.T.T., S. Ryder, R.T.T., T. Sydorchuk, R.T.T.
Technologists — H. Doherty, R.T.T., T. Engel, R.T.T., J. Firby, R.T.T., J. Grestoni, R.T.T., J. Halfdanson, R.T.T., C. Marlowe, R.T.(R&T), S. Mehta, R.T.T., D. Swanson, R.T.T., K. Wedlake, R.T.T., G. Winski, R.T.T.

**Student Radiotherapy Technologists:**
T. Corkum, T. Depape, S. Iftody, R. Kubisch, C. Speiss (Second Year)
D. Bettig, T. Hawton, L. Radcliffe, D. Willits

## ST. BONIFACE NURSING AND TECHNOLOGY STAFF:

G. Ogilvie, R.N., R.T.T., Senior Nurse
S. Hatton, R.N., R.T.T., B. Lucko, R.N., R. Olson, R.N., R.T.T.,
S. Sharpe, R.T.(R&T).

## ONCOLOGY NURSING/TECHNOLOGY

Provision of quality patient care is the main goal of the Department of Nursing. Nurses from the Foundation along with other oncology nurses in Manitoba have been diligently preparing Oncology Nursing Standards of Practice. These standards when completed will have the approval of M.A.R.N. and will become the Standard of Practice for all Oncology Nurses practicing within the province.

A Nursing Forms Committee was established to review and update nursing documentation. New formats will be designed which will accurately reflect the standards.

Discharge planning is a major focus of the Manitoba Cancer Treatment and Research Foundation nursing staff. With careful planning and coordination the staff is often able to keep patients comfortable at home. The number of patients being treated with more complex treatment regimes on an outpatient basis is continually increasing. This largely is possible due to our dedicated, caring and exceptionally knowledgeable staff. This change in treatment venue is not only cost effective but allows patients to remain at home with their families.

Pediatric nursing programs, under the able direction of Pat Pruden, (reported under Pediatric Oncology) continues to be a source of pride to the Foundation nursing staff.

The Hemophilia Service now operates from the Manitoba Cancer Treatment and Research Foundation with N. Schwetz and S. Switzer coordinating the hemophilia care.

Our educational goals have related to nursing orientation, staff development, education for allied health care professionals within and outside the Foundation as well as patient and family education.

Eighty-one nurses or technologists have attended our three day nursing lecture series. The lecture series coordinated by J. Lutz is available to all nurses as a continuing education seminar. Its main purpose, however, is to provide information to those nurses already working in oncology or to prepare those entering the field. Those that are entering the field follow the three day theory program with a three week practicum. Four nurses participated in the clinical practicum this year under the direction of N. Johnson the Head Nurse in Medical Oncology.

Inservice lectures have been well attended and ably organized by J. Lutz.

Fifteen of our staff attended outside seminars and workshops in 1986. Many allied health care professionals identified their need for more information on cancer and the care of the cancer patient. Many lectures covering a variety of topics have been given to these groups.

An increasing number of nursing students from the Bachelor of Nursing and diploma programs choose oncology nursing as their elective. This has proven to be a very rewarding part of the nurses educational experience.

The Radiotherapy Treatment Floor has experienced a number of changes in terms of personnel and hours of work this past year.

V. Pruden and D. Wells both retired in the spring of 1986 following 28 and 23 years of employment respectively. Their retirement signifies an end of an era. They were the last two nurse technologists working on the treatment floor at the M. R. McCharles Unit.

Due to an increase in patient numbers it became necessary to expand the hours of operation from 13 hour to a 15 hour day.

Patient care and safety could not be compromised, therefore two extra technologists were employed in order to extend the hours of operation.

The Gynecology and Surgical Oncology nurses play an ever increasing role in these areas as the need for patient education and support grow with the complexity of treatments.

The Department of Nursing is extremely busy and active and strives to maintain a high standard of excellence in all of its endeavors.

## RADIOTHERAPY TECHNOLOGIST TRAINING PROGRAM

*E. Kirk*

The Manitoba Cancer Treatment and Research Foundation in affiliation with Red River Community College continues to provide those persons interested in a career in oncology, the opportunity to become certified as a Radiation Therapy Technologist.

As with many other programs in the health care field, ongoing evaluation of the needs of patients, the necessity to accommodate technological change, combined in the varying needs of students, has resulted in a number of changes in this program over the years. 1986 proved to be no different in this regard. After much deliberation on the part of the Education Program Committee, staff who participate in the programs, as well as students, past and present, it was determined that our goals and objectives might be more adequately met if the students spent a larger percentage of their time at the Cancer Foundation. This would then lessen the participation of R.R.C.C. in their program. At the present time this is being studied more closely, with a decision forth-coming early in the New Year.

1986 saw the appointment of a Deputy Program Coordinator for this program, funded by an increase in student tuition fees. We welcomed Ms. Nancy Saunders to this position on July 1, and have seen commitment to both the students and the program over the last six months. With the retirement of Dr. J. Gillies, we have also had a change in the Medical Director of the program, with the appointment of Dr. K. Malaker to the position. A very special thanks to Dr. Gillies, who, over the years, consistantly supported both the staff and students participating in this program.

Four graduates of our Program wrote and passed the National C.A.M.R.T. certification examinations in 1986. Our congratulations to Trina Walker, Tannis Erwin, Kelly Patterson and Karen Wedlake. Special congratulations to Karen who was also the recipient of the Picker Award, a general proficiency award in Radiation Therapy Technology, and the M.A.M.R.T. Essay Competition.

As of December, 1986, we had nine students enrolled in the program. Interest in the program continues to grow, with 78 persons applying for the five student positions available in 1986.

# HEMATOLOGY LABORATORY

## CHIEF TECHNOLOGIST

Elsa Friesen, A.R.T.

## MEDICAL TECHNOLOGISTS

Marlene Crielaard, R.T.; Dianne Gamble, R.T.; Jennine Olivier, R.T.; Susan Tighe, R.T.; Leona St. Onge, R.T. (Part time)

This laboratory is responsible for all the routine hematological investigations including bone marrow aspirates from the out-patient population attending the clinics within the Foundation. As the majority of the patients have abnormal blood profiles this necesitates visual differentiation of cell types and frequently confirmation of values obtained by electronic counting. The presence of the laboratory in the clinic area enables a preliminary report to be available to the physician within five minutes after obtaining the blood sample. This makes it possible for chemotherapy and radiotherapy to proceed on these patients without delay. The number of patients visiting the laboratory in 1986 was 17,820 as compared with 16,822 patient visits in 1985.

# MEDICAL ONCOLOGY

**Director** — David M. Bowman, M.D., B.Sc.(Med), F.R.C.P.(C)

## MEDICAL ONCOLOGISTS

L. Brandes, M.D., B.Sc.(Med), F.R.C.P.(C)
J. Foerster, M.D., B.Sc.(Med)
G. Goldenberg, M.D., Ph.D., F.R.C.P.(C)
L. G. Israels, B.A., M.D., M.Sc., F.R.C.P.(C)
J. Johnston, M.B., F.R.C.P.(C)
M. Levitt, M.D., M.Sc., F.R.C.P.(C)
B. Schacter, M.D., B.Sc.(Med), F.R.C.P.(C)

## CLINIC ASSISTANT

L. Pratt, M.D.

## CLINICAL FELLOW

T. Nijjar, M.D.

## RESIDENTS

C. Bradley, M.D., T. Wong, M.D., G. Thompson, M.D., S. Vizal, M.D., N. Lerner, M.D., P. Orr, M.D., S. Chater, M.D., W. Leslie, M.D., K. Wolfe, M.D., D. Wong, M.D.

## NURSING STAFF

N. Johnson (Senior Chemotherapy Nurse)

### Clinical Nurses

S. Bracken, I. Chrynuk, L. Friesen, E. Nelson, S. Switzer, D. Rumpel

### Nursing Aides

I. De Sousa, G. Harney, L. Jonasson, U. Merck

## CLINICAL INVESTIGATION OFFICE

**Director** — M. Levitt, M.D., M.Sc., F.R.C.P.(C)
**Protocol Nurse Co-ordinator** — J. Lutz, R.N.
**Protocol Nurse:** K. McDonald, R.N.

### Protocol Technicians

K. Hjalmarsson-Taylor, E. Janke, H. Kampen, L. Love, E. Stiles

### Clinic Receptionist

C. Jones

### Departmental Secretaries

J. Powell, T. Reutcky

# MEDICAL ONCOLOGY*

## ORGANIZATION

The Manitoba Cancer Treatment and Research Foundation Department of Medical Oncology provides programmes for diagnosis and management of adults with neoplastic and hematologic diseases in Manitoba. Patients are also referred from neighbouring provinces and states. Facilities are maintained geographically at the Foundation and at St. Boniface General Hospital (See also report of "Oncology Unit — St. Boniface General Hospital"). The Foundation also coordinates a Cancer Outreach Programme to provide rural patients and their families with optimal standards of care close to their home environment. All Medical Staff have full-time appointments at the University of Manitoba and most are actively conducting programmes of basic research and/or clinical investigation.

The Oncology Centre at the Foundation is an Outpatient facility also housing the research programmes of the Manitoba Institute of Cell Biology, such that basic research, clinical investigation and patient care programmes are intimately related. The Department of Medical Oncology includes eight medical oncologists, who provide care for patients with malignant and hematologic diseases. In addition, close liaisons with radiation oncology, gynaecological, urological and surgical oncology, plus pediatric oncology are maintained. The professional team includes oncology nurses specialized in parenteral administration of chemotherapy and immunotherapy. The Radiation Oncology service is also located within the Oncology Centre, thus, facilitating interdisciplinary approaches to cancer care. A hematology laboratory at the Oncology Centre provides hematologic data of high quality promptly and efficiently to all of the clinics as is essential to the ongoing care of both urban and rural patients. Other patient services in the Oncology Centre include a special cancer-oriented Social Service, and Epidemiology and Statistics Section. These outpatient services are integrated with the inpatient services of the adjacent Health Sciences Centre. Thus, when necessary, patients are admitted to the clinical teaching units of the General Centre (HSC). Here they are cared for by the House Officers and the Oncology Fellows under the supervision of the senior consultant of the Medical Oncology Service. The Medical Oncology Service also provides the Hematology/Oncology consulting service to inpatients of the Health Sciences Centre.

During the first half of 1986, Dr. G. J. Goldenberg was on sabbatical leave for a six month period of time at the Dana Farber Cancer Institute of Harvard Medical School, Boston, Massachusetts. The majority of his time was devoted to acquiring expertise with techniques in molecular biology, working in the laboratory of Dr. W. A. Haseltine, Director of the Division of Biochemical Pharmacology. In addition, Dr. Goldenberg was able to observe the treatment of patients with aggressive chemotherapy, including combinations of several alkylating agents in conjunction with autologous bone marrow rescue, a program referred to as STAMP (sold tumor autologous marrow transplant program).

During the last four months of 1986, Dr. Brent Schacter was on sabbatical leave in the laboratory of Dr. Robert Troxler, in the Department of Biochemistry at Boston University Medical School. His sabbatical studies involved research on purified bovine spleen heme oxygenase and the development of a complementary DNA probe of the structural gene for heme oxygenase.

*See also report of "Oncology Unit — St. Boniface General Hospital."

## TEACHING

In addition to the service component involved in care of ambulatory patients with neoplastic disease, the Medical Oncology Service provides teaching for students at an Undergraduate level through lectures in Hematology and Oncology, and a laboratory hematology course; and at the graduate level of Interns and Residents in the Department of Medicine. Full-time Clinical Fellows and Residents in Internal Medicine rotate on the Hematology/Oncology Service, both at the Health Sciences Centre and St. Boniface Hospital. In addition, they participate in the Clinical and Research Seminars and Rounds of the Department as well as resident Clinical Seminars. All third year undergraduate medical students at the University of Manitoba are given a series of Hematology case reviews under the supervision of various members of the Attending Staff and the Hematology Fellows. Some of the fourth year medical students also participated in one-month selectives on the Hematology/Oncology Service. The Hematology/Oncology Morphology Teaching Laboratory under the direction of Ms. A. Sasyniuk, R.T., B.Sc., participates fully with the Medical Oncology Department including the St. Boniface Hospital Unit, in the teaching of Medical and Pediatric fellows and rotating residents, as well as the fourth year clerks and third year clerks participating in the Hematology/Oncology electives.

The purpose of this laboratory is to:

1. Coordinate the clinical teaching with the laboratory data.
2. Train fellows, residents and clinical clerks in the Hematology/Oncology programme to interpret the morphology of the peripheral blood and bone marrows obtained from patients they have seen in clinic or admitted to hospital.
3. Give each clinical clerk during their elective a caseload of patients, representative of the spectrum of ages in normal and disease states. Therefore, providing students with experience to develop efficiency in obtaining relevant history, to recognize life threatening problems and to establish priorities in management in acute and chronic situations.

The schedule provides 4-6 hours/week training in examination of morphology and interpretation of peripheral blood smears, bone marrows and biopsies on a one to one basis. Each student has the opportunity to examine the above material at the time of diagnosis, during treatment, and during remission.

For those who choose to rotate through this program the major emphasis of this laboratory is to integrate and to broaden the understanding in Hematology/Oncology. It also provides an opportunity to gain first hand experience at interpretation of peripheral blood smears and bone marrow smears and a more fuller utilization of useful diagnostic tests.

During 1986 the rotation included 8 residents in pediatrics, 4 residents in pathology, 10 undergraduate selective rotations and 10 residents in internal medicine for rotations varying between 2 and 12 months. The excellent teaching in the laboratory was provided by Ann Sasyniuk, assisted by Betty Jacobucci. The program is an important complementary experience for physicians in pediatric pathology and internal medicine.

Visiting Professors contributing to the teaching program during 1986 included Dr. Gordon Phillips, Director of the British Columbia Bone Marrow Transplant Program, speaking on "Bone Marrow Transplantation for Acute Myelogenous Leukemia", Dr. Norma Ramsay, University of Minnesota speaking on Pediatric Bone Marrow Transplantation Programs", and Dr. Ernest Pohlman, University of Toronto, whose topic was "Psychiatric Consultation to an Oncology Service".

## BASIC RESEARCH

The clinical facility on the ground floor of the Oncology Centre is intimately juxtaposed with the Manitoba Institute of Cell Biology, which is situated on the second floor of the same building. This relationship allows sophisticated tests and expert consultations to be immediately available from laboratories doing research in tumour immunology, blood coagulation, molecular biology, and membrane transport of chemotherapeutic agents. Please see the separate report of the Manitoba Institute of Cell Biology for descriptive details.

## CLINICAL INVESTIGATION

New developments in medical therapy of cancer have made the conduct of a clinical investigation programme the cornerstone of developing cancer treatment programmes. In Medical Oncology, programmes of clinical investigation are carried out both on an independent basis, and in collaboration with major clinical trial co-operative groups.

The Protocol Review Committee, with multidisciplinary membership evaluates and approves all new clinical protocols involving the Manitoba Cancer Treatment and Research Foundation patients. Committee membership includes Drs. M. Levitt (Chairman), D. Bowman, B. Weinerman, K. Malaker, G. Krepart, M. Kobrinsky, and L. G. Israels.

The Department of Medical Oncology also participates in clinical trials sponsored by several national and international clinical trial co-operative groups, including the National Cancer Institute of Canada (NCIC — Principal Investigator — Dr. M. Levitt), and the National Surgical Programme for Breast and Bowel Cancers (NSABP — Principal Investigator, Dr. D. M. Bowman). Participation in numerous protocols with these co-operative groups and institutions remains a high priority of medical oncology. We believe these multi-institutional co-operative trials represent the forefront of developmental cancer therapeutics. Table I, which follows, indicates our participation in these protocols during recent year.

A Data Quality Assurance Monitoring Committee monitors the quality of accruing data on all approved protocols, and has member representation by all of the Foundation's clinical departments.

## TABLE I

## CLINICAL INVESTIGATIVE PROTOCOL ACCRUAL — ADULT

| **Study Group:** | **1985** | **1986** |
|---|---|---|
| *NCIC* | | |
| Remaining On-Study from Prior Years | 341 | 337 |
| New Patient Accrual | 69 | 46 |
| Off Study | 73 | 32 |
| Remaining On-Study | 337 | 351 |
| *NSABP* | | |
| Remaining On-Study from Prior Years | 314 | 347 |
| New Patient Accrual | 55 | 43 |
| Off Study | 22 | 16 |
| Remaining On-Study | 347 | 374 |
| *LOCAL TRIALS** | | |
| Remaining On-Study from Prior Years | 45 | 58 |
| New Patient Accrual | 48 | 95 |
| Off Study | 35 | 55 |
| Remaining On-Study | 58 | 98 |
| **Total On-Study (Year End)** | **742** | **823** |

***1986 New patient accrual includes acute non-lymphocytic leukemia protocol patients not previously (1983-86) documented.**

****Please also see report of Department of Pediatrics regarding Pediatric Clinical Investigation.**

The following is a brief description of active clinical investigative trials.

| **Disease Site** | **Number** | **Description** |
|---|---|---|
| Ovarian Carcinoma | NCIC<br>OV.6 | Non-randomized study to determine the efficacy of surgery alone in patients with Stage IA or Stage IB disease when extensive surgical staging has also been done to confirm limited disease. |
| | NCIC<br>OV.7 | To compare current optimum chemotherapy with abdominopelvic irradiation in Stage IC, IIA, B, C, or III, with microscopic disease.<br>1. RT to abdomen x 22 treatments and RT to pelvis x 11 treatments<br>VERSUS<br>2. Cyclophosphamide i.v. and Cis-Platinum i.v. q4 weeks x 9 courses. |

| | | |
|---|---|---|
| | NCIC<br>OV.8 | To compare Carboplatin plus Cyclophosphamide in patients with macroscopic residual disease. Responders receive 3 more courses of original chemotherapy versus RT to abdomen x 22 treatments and RT to pelvis x 11 treatments. |
| Lung Carcinoma | NCIC<br>BR.5 | To compare two chemotherapy regimens and to evaluate changes in "Quality of Life".<br>1. Vindesine day 1, weekly x 4, then q 2 weeks. Cis-platinum, day 1, day 36, then q 2 weeks<br>VERSUS<br>Cyclophosphamide, Adriamycin, Cis-Platinum q 4 weeks. |
| | NCIC<br>BR.6 | To compare early versus late radiotherapy in limited small cell carcinoma for patients being treated with Cyclophosphamide i.v., Adriamycain i.v., VIncristine i.v., Cycles 1,3,5, alternating with VP-16 i.v. Cis-Platinum i.v. daily x 3 days cycles 2,4,6. |
| | NCIC<br>IND.31 | To determine the antitumor efficacy of VP-16 and carboplatin given every 4 weeks in patients with measurable extensive small cell lung cancer. |
| | NCIC<br>IND.33 | Non-randomized study to determine the response rate of patients with extensive, previously untreated, small cell bronchogenic carcinoma to Epirubicin administered i.v. q 3 weeks, given in an escalating dose schedule. |
| | MBR<br>86.1 | A randomized study to compare the toxicity and effectiveness of radiotherapy plus Lonidamine with "standard" radiotherapy itself in patients with inoperable non-small cell lung cancers without distant metastases. |
| | MMT<br>86.3 | To determine the response rate to Epirubicin administered at escalating doses as an i.v. bolus, every 3 weeks in patients with malignant pleural and/or peritoneal mesothelioma. |
| Lymphoma | NCIC<br>LY.3 | Comparison of Standard BACOP chemotherapy with escalated BACOP in "poor prognosis" histology. |
| | NCIC<br>IND.16 | To investigate the effectiveness of Acivicin (AT-125) in patients with poor prognosis. Non-Hodgkin's lymphoma in whom conventional treatment(s) are ineffective. |

| | | |
|---|---|---|
| | N.NHL 85.5 | To compare efficacy, toxicity and evaluate quality of life between Cyclophosphamide, Vincristine, Prednisone and Epirubicin, Vincristine, Prednisone in the treatment of favourable histology Non-Hodgkin's Lymphoma Stage IIB, IIIA & B, and IVA and B. |
| Hairy-Cell Leukemia | NCIC IND.22 | To determine the response and toxicity of hairy cell leukemia to 2'-Deoxycoformycin (DCF) given in a low dose intermittent schedule. |
| | NCIC HL 1 | A randomized comparison of Deoxycoformycin VS Alpha-Interferon in previously untreated patients with Hairy Cell Leukemia. |
| Chronic Lymphatic Leukemia | M.CLL 82.1 | To determine the response rate of patients with refractory CLL to weekly doses of 2'-Deoxycoformycin (Phase II). |
| Hodgkin's Disease | NCIC HD.4 | To study the effectiveness of MOPP/ABV Hybrid chemotherapy versus alternating MOPP/ABVD for remission induction, durability and survival in advanced or recurrent disease. |
| Multiple Myeloma | N.MY 84.1 | Pilot study of weekly cyclophosphamide and alternate day Prednisone therapy (CWAP) as primary treatment in multiple myeloma, Stages 1-4. |
| Malignant Melanoma | NCIC ME.5 | Surgical study to determine the safest excision margins around the primary melanoma and to evalute the management of the regional lymph nodes. A national intergroup protocol. |
| | NCIC IND.26 | To determine efficacy of Trimetrexate in metastatic malignant melanoma, with evaluation of objective responses and duration of responses, toxicity, in patients receiving this drug in an intravenous schedule (Phase II). |
| Colorectal Carcinoma | NSABP C-02 | To evaluate postoperative portal vein infusion of 5-FU in resectable adenocarcinoma of colon. |
| | NCIC C0.2 | To determine the response rate and survival of patients with metastatic colorectal cancer using 5-FU Continuous systemic infusion x 14 days q 28 days versus 5-FU intravenously by bolus x 5 days q 28 days. |
| | MCR 85.9 | To determine the efficacy and toxicity of Methotrexate and 5-FU (with leukovorin rescue) in patients with advanced colon or rectal carcinoma. |

| | | |
|---|---|---|
| Rectal Carcinoma | NSABP R-01 | To compare no treatment versus combination chemotherapy versus radiotherapy in patients with Duke's B or C rectal carcinoma after surgery. |
| Breast Carcinoma | NCIC MA.4 | To compare Tamoxifen versus Tamoxifen plus combination chemotherapy in patients witn ER or PR positive stage II breast carcinoma. |
| | NSABP B-13 | To compare no treatment versus combination chemotherapy in patients with ER and PR negative stage I breast carcinoma. |
| | NSABP B-14 | To compare placebo versus Tamoxifen in patients with ER or PR positive stage I breast carcinoma. |
| | NSABP B-15 | To compare Adriamycin plus Cyclophosphamide versus Cyclophosphamide + Methotrexate + 5-FU versus both regimens sequentially in patients with PR negative stage II breast carcinoma. |
| | NSABP B-16 | To compare no chemotherapy versus Adriamycin + Cyclophosphamide versus Melphalan + 5-FU in patients with PR positive stage II breast carcinoma. |
| | NSABP B-17 | Randomized study to evaluate postoperative breast irradiation following segmental mastectomy plus axillary dissection in patients with non-invasive intraductal adenocarcinoma.<br>No treatment VS breast radiation therapy. |
| | M.B. 86.4 | Randomized parallel comparison of two regimens as first-line chemotherapy for advanced breast cancer: Cyclo-phosphamide - Novantrone - 5-Fluorouracil VS Cyclophosphamide - Adriamycin - 5-Fluorouracil. |
| Gastric Carcinoma | M-GA 85.4 | To compare efficacy and evaluate quality of life of Epirubicin plus 5-Fluorouracil VS 5-FU alone VS Epirubicin alone in the treatment of locally advanced disseminated gastric cancer. |
| Prostate Carcinoma | M.PR. 85.2 | To assess the effectiveness of the antiandrogen (RU-23908) and orchiectomy by comparing orchiectomy and placebo in Stage D2 prostate cancer. |
| | M.PR. 85.3 | To compare the efficacy and toxicity of ketoconazole VS diethylstilbestrol in the treatment of Stage D prostate cancer. |

| | | |
|---|---|---|
| | PR<br>86.2 | To determine whether Epirubicin, given as an intravenous injection q 3 weeks, produces responses in patients with hormone resistant prostatic carcinoma with measurable disease. |
| Renal Carcinoma | NCIC<br>IND.24 | To assess the antitumor effect of 2'-Deoxycoformycin (DCF) given as a weekly i.v infusion in patients with metastatic measurable renal cell carcinoma. |
| Bladder Carcinoma | BL<br>85.10 | To evaluate in a randomized, double-blind trial, the efficacy of INTRON A in patients with superficial bladder cancer — specifically carcinoma-in-situ. |
| Laryngeal Carcinoma | M.H.&N.<br>82.1 | To compare radiotherapy versus radiotherapy + combination chemotherapy in patients with advanced carcinoma of larynx or hypopharynx without distant metastases. |
| Head and Neck | M.H.&N.<br>84.3 | To determine efficacy of high dose Methotrexate + PaLa chemotherapy in patients with advanced head and neck carcinoma. |
| Sarcoma | M.SA<br>80.1 | To determine whether Metronidazole is synergistic with Adriamycin in patients with advanced soft tissue sarcoma. |
| Metastatic Carcinoma | M.CA<br>85.8 | To determine primarily toxicity, and secondly effectiveness, of Lonidamine + Interferon in metastatic carcinoma patients for whom there is no effective conventional treatment. |
| Supportive Care | M.SC<br>83.9 | To compare sustained release morphine tablets versus oral morphine liquid in cancer analgesia. |
| | M.SC<br>85.7 | To determine the effectiveness of piroxicam added to morphine as an analgesic in cancer patients. |

## MEDICAL ONCOLOGY NURSING

Medical Oncology Nursing at the Foundation is led by Nancy Johnson in the Chemotherapy Clinic with a staff of six chemotherapy nurses and four nursing aides devoted to the education, support, and particularly expert administration of parenteral chemotherapy for their patients. Janice Lutz, Assistant Director of Nursing, also assists as Clinical Investigation Liaison Nurse with the Clinical Investigation Office. Protocol Nurse, Kerry McDonald now provides the nursing co-ordination between Medical Oncology clinics and the Clinical Investigation Office.

Medical Oncology Nurses participate in Respiratory Rounds with the staff at the Respiratory Centre to improve follow-up care of lung cancer patients. Similarily, regular Nursing Conjoint Rounds with Social Service have been beneficial in identifying high risk situations and intervening with appropriate measures to prevent crisis development. Increasing awareness of the role of the Oncology nurse by the University of Manitoba and Health Sciences Centre Schools of Nursing has been evidenced by placement of senior nursing students at the Foundation as part of their clinical experience. Education in the wider community continues to be encouraged and the medical oncology nurses' lecture programmes continue to attract nursing attendance from throughout the province. The nursing staff also frequently act as guest speakers at other urban and rural health institutions. Continued participation in national and international oncology meetings enhances skillful evaluation and counselling for patients and their families.

Our two nurse oncologists who completed the Faculty of Medicine second year undergraduate programme in physical diagnosis previously are proficient in assisting medical oncologists in clinical evaluation of patients at the Oncology Centre. In addition, they provide a critical liaison between patient care in the clinic and clinical investigation (protocol) activities including evaluation of patients with respect to eligibility, informed consent, and on-going assessment during therapeutic trials. Nursing research is fostered in conjunction with the University of Manitoba School of Nursing and with National Cancer Institute, National Surgical Adjuvant Breast and Bowel Programme, as well as institutional protocols.

A new Brain Tumor multidisciplinary clinic was instituted during the latter portion of 1986.

A Hemophilia Clinic now operates from the Foundation, co-ordinating adult hemophilia care.

Nursing members are actively participating on a provincial committee with the Manitoba Association of Registered Nurses in developing comprehensive standards for the emerging specialty of Oncology Nursing.

## PATIENT CARE

Optimal patient care is in the primary objective of the Department of Medical Oncology. The Medical Oncology Clinic, in conjunction with the unit at St. Boniface Hospital, serves as the Manitoba referral centre for care of patients with neoplastic and hematologic diseases. The adult clinic also operates in close co-operation with active pediatric oncology clinics, which are reported in detail elsewhere in this Report. While the clinic itself is strictly an ambulatory (outpatient) facility, all attending oncologists hold major University of Manitoba appointments and are on active staff at the contiguously adjacent General Centre of the Health Sciences Centre. Accordingly, patients requiring admission to Hospital are admitted to the General Centre, where they are attended in continuity by their medical oncologist.

During 1986, agreement was approved with the Health Sciences Centre and the Manitoba Health Services Commission to redevelop a 19 bed ward (D-6) at the General Centre as an interim, dedicated clinical teaching inpatient unit. The physical renovations to allow such are expected to be completed early in 1988.

Table II illustrates the ambulatory (out-patient) services. (See also separate report for St. Boniface Hospital Unit).

## TABLE II
## MCF MEDICAL ONCOLOGY PATIENT STATISTICS#

| | New Patients# | Follow-up Visit | Total Physician Clinic Visits | Number of Treatment Courses |
|---|---|---|---|---|
| 1980* | 365 | 5049 | 5414 | 1976 |
| 1981* | 554 | 6894 | 7448 | 2619 |
| 1982* | 620 | 8249 | 8869 | 3885 |
| 1983 | 293 | 5107 | 5400 | 3269 |
| 1984 | 287 | 5125 | 5412 | 3584 |
| 1985 | 291 | 5313 | 5604 | 3717 |
| 1986 | 286 | 5578 | 5864 | 3811 |

*Figures for the years 1980-1982 include St. Boniface General Hospital medical oncology patients, plus MCTRF gynaecological, surgical, and urological clinics. Since 1982 these patient statistics are presented in their respective sections of the Report.

#These figures do not include approximately 400 consultations provided by Department members to in-patients located at the Health Sciences (General Centre).

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## PEDIATRIC ONCOLOGY

**Section Head** — J. M. Gerrard, M.D., Ph.D., F.R.C.P.(C)
A. J. Bishop, B.Sc., M.D., F.R.C.P.(C)
E. D. Israels, B.A., M.D., M.Sc.
S. J. Israels, M.D., F.R.C.P.(C)
N. L. Kobrinsky, B.Sc.(Med.), M.D., F.A.A.P., F.R.C.P.(C)
M. L. Schroeder, M.D., F.R.C.P.(C)

### ONCOLOGY NURSE

P. Pruden, R.N.

### HOME CARE CO-ORDINATOR

K. McRae, R.N.

### SOCIAL WORKER

S. Powell, B.S.W.

### PSYCHOLOGIST

S. Goszer-Tritt, Ph.D., M.A., B.A.

### PSYCHIATRIST

K. Kluner, M.D., F.R.C.P.(C)

### CHILD LIFE THERAPIST

Dawn Kidder, C.C.L.S.

### TEACHER

J. Wright, B.A., B.Ed.

### DATA MANAGERS

L. Janke, M.R.T., H. Kampen, M.R.T., K. Hjalmarsson, M.R.T.

### CHAPLAIN

A. Goodwin, B.Sc.N., M.Div.

### RESIDENTS

M. Levin, E. Enns

### SUPPORT STAFF

L. Devlin, N. Eyolfson, J. Powell

## PATIENT CARE

The Pediatric Section is the major referral centre for children with oncological diseases for the Province of Manitoba and has developed a comprehensive care program for pediatric patients with cancer. Out-patient services are co-ordinated through the Cancer Foundation and in-patient care is co-ordinated through the Children's Hospital. A treatment team including a pediatric oncologist, a social worker, oncology nurse, homecare co-ordinator, child life therapist, teacher and chaplain are responsible for directing the treatment program of the individual patient whether the care setting is out-patient, in-patient or home.

The oncology nurse, Pat Pruden, plays a major role not only in the administration of chemotherapy, but also in the education of the patient and his or her family, friends and school with regard to the illness, therapy and complications of therapy. She also provides inservice educational sessions for paramedical personnel who participate in the care of the child with cancer, and co-ordinates weekly meetings of the entire treatment team. In addition, Pat made presentations to the Manitoba Neurology Nurses, the Canadian University Nurses Association and the Canadian Cancer Society Annual Meeting in Brandon.

The psychological support services continue to be provided by one social worker, Susan Powell, from the Children's Hospital. The service fully recognizes that a life-threatening illness in a child has major implications for the entire family. Every family has an opportunity to meet with the social worker, and if the need arises, counselling services are provided for the patient and other members of the family. Crises prevention is an important aspect of this support service. The social worker provides an essential liaison role with the Children's Hospital in community resources to assist families with practical and emotional support. She assists in organizing information meetings for new families to familiarize them with the clinic and staff. Susan Powell has also been helpful in the on-going activities of a self-help group for parents who have a child with Immune Thrombocytopenic Purpura (ITP), teenagers with cancer, and provides support and information to the parent self-help group, "Jeffrey's Folks" which provides one-to-one support for any parent of a child newly diagnosed with cancer who would like to meet and talk with another parent who has experienced having a child with cancer. The teen group met every two weeks and was generally well attended by children on and off treatment. A summer barbecue and Christmas party were also held. The parents' support group, Jeffrey's Folks, continues as a satellite group of the Service-to-Patients Committee of the Canadian Cancer Society. This allows financial independence and a wider access to the public. Through the generosity of the Canadian Cancer Society, a week-end camp was, again, held for the patients and their siblings at Arnes, Manitoba. This camp is unique in that there are scheduled workshops to explore emotions of both patients and siblings. The week-end was a great success. A major presentation entitled "Camping Together — A therapeutic experience for oncology patients and their siblings" highlighting the camps' success was given by Susan Powell and Joyce Wright at the Annual Association for the Care of Children's Health Conference held in San Francisco in June, 1987.

The Child Life Therapist, Dawn Kidder, provides a psychosocial service for patients and families in the waiting-room, in-hospital and when appropriate, at the child's home. The goals of the Child Life Program are to minimize stress and anxiety for the child and adolescent, to provide essential life experiences, to provide opportunities to retain self-esteem and appropriate independence, to ensure recognition of the child as a unique individual and develop a trusting relationship with the child and his/her family and to provide home visits. These goals are reached through the use of many tools including programs to acquaint children with the many departments within the hospital, medical play with medical equipment and anatomically correct puppets, demonstrating medical procedures such as bone marrow aspirations and spinal taps, modeling relaxation techniques for tension release and acquiring mastery and the provision of developmentally appropriate activities. Dawn Kidder is an active member of the Association of the Care of Children's Health. She has made presentations to the Manitoba Association of Medical Radiation Technologists, "Jeffrey's Folks" and within the Child Life department.

We are grateful to the Committee of the Children's Chemotherapy Facilities Fund for providing additional equipment for the children visiting in the chemotherapy area.

The need to provide a wide range of educational services for students receiving treatment at the Cancer Foundation has been recognized for some years. Joyce Wright continues to effectively fill this position and to develop a model based on service needs and demands. Children who are under the care of the Cancer Foundation are strongly encouraged to carry out as normal a lifestyle as possible, including regular school attendance. On occasion due to distance from home or to the complexity of the treatment program this is not possible. Children are then kept current in their school program either by provision of one-on-one tutoring by the oncology teacher or where it is appropriate to involve the child in a classroom setting (especially the young child who needs group activities), the child is introduced into the class at the Children's Hospital. The teacher maintains an on-going liaison with the home school, and in addition, visits the patient's school often with the oncology nurse and social worker. The objective of these visits is to help both teachers and classmates understand and be more comfortable with the child with cancer. Each visit is designed to meet the needs of a particular situation. The home school may draw upon administration, resource teachers, guidance personnel and special education co-ordinators. We are grateful to the Canadian Cancer Society for providing the funds for the travel required to the rural schools. We are also grateful to the Winnipeg School Division No. 1 for the recent change of Joyce Wright from part-time to full-time.

The oncology teacher, nurse and social worker will also visit, if requested, classrooms of children who have cancer or who have died of cancer to discuss various aspects of cancer with the students and teachers. As part of this program, entire classes have visited the clinic area. The young students learn a great deal and are sensitized in a non-threatening manner. They have the opportunity to view an examination room, medical instruments and equipment and receive an explanation or demonstration of procedures. Members of the class gain an understanding of the clinic environment and an appreciation of what the classmate, the patient, experiences. The patient benefits greatly from the increased understanding of his classmates. For both, much of the mystique and fear has vanished. Very positive feedback has occurred from these field trips. Teachers have commented on how easily the children were able to discuss cancer. This program also fulfills the important role of the Foundation in educating the public. With the co-operation of the Cancer Foundation, the Children's Hospital of Winnipeg and the Winnipeg School Division No. 1, workshops for teachers in the province who have children with cancer in their classrooms, are now an annual event. The Section appreciates the response received from the provincial Department of Education, in particular Winnipeg School Division No. 1, in seeking methods and resources for meeting these needs. In 1986, this program was highly successful in 28 meetings with teachers, 11 class meetings and 5 classroom tours of our premises. In addition, a one day conference was held in November for educators dealing with children with cancer. Joyce Wright made presentations at the Many Faces of Grief Workshop, Pediatric Rounds in June entitled "School Performance of Children with Cancer", and the Children living with Cancer Workshop in December. She copresented with Susan Powell at the Annual Association for the Care of Children's Health Conference in San Francisco in June.

Dr. Kerry Kluner joined the staff of the Children's Hospital this year as a psychiatrist. Dr. Kluner has taken a particular interest in patients with cancer and their families. We welcome his contribution and his active participation in the psychosocial support team.

We continue to be grateful for the support services given to the staff, patients and their families by the chaplaincy of Reverend Ann Goodwin. The role of hospital chaplains in the pediatric oncology program is also one which is challenging and one from which we are gaining an understanding of the spiritual needs of children.

Ronald McDonald House, a facility which provides "a home away from home" for the rural families undergoing therapy in Winnipeg, was opened in the spring of 1984 and continues to play a very important role in 1986. The many parents, patients, members of the therapy team and administration representatives of the Children's Hospital who gave much time and energy in the establishment of this House, continue to play a large role in its maintenance. This facility has enriched our program and has added greatly to the support system of our rural patients.

The Section of Pediatric Oncology is part of the Children's Cancer Study Group, a group comprised of people from institutions at the forefront of the treatment of cancer throughout North America. As part of our involvement with the Children's Cancer Study Group, we participate in treatment protocols and studies which have been very carefully designed to provide cancer patients in Manitoba with the most up-to-date treatment. At the same time this program allows the introduction of new treatment programs in such a way that we can carefully evaluate them. Programs such as these with the Children's Cancer Study Group have been largely responsible for the improvement of a number of childhood cancers. Particularly remarkable has been the gradual improvement of children with some forms of acute lymphocytic leukemia (ALL) who can now be cured in about 8 out of 10 cases. Significant but less dramatic progress has been made in many other forms of childhood cancer, and we hope through this and other programs to continue this improvement.

Full support is available from the Department of Pediatrics, University of Manitoba in essential sub-specialties such as immunology, allergy, infectious disease, neurology, genetics, endocrinology, surgical sub-specialties, metabolism, nutrition and child development.

The Section is grateful for the support and co-operation of the Administration of the Foundation, the Children's Hospital and Winnipeg School Division No. 1, in allowing personnel to cross institutional, geographical and functional boundaries, since, without this support, true comprehensive care for the pediatric oncology patient would not be possible. The Section also is grateful to the Canadian Cancer Society for the assistance which it has given us in the development of many of our support programs. We are also grateful to the Committee to the Children's Chemotherapy Facilities Fund for the purchase of the cryopreservation unit to freeze and preserve bone marrow cells.

## Out-Patient Statistics, 1986

### TABLE I:
### Pediatric Oncology Patients at the Manitoba Cancer Treatment and Research Foundation

| | On Therapy | Off Therapy | Total |
|---|---|---|---|
| 1971 | 23 | 12 | 45 |
| 1980 | 75 | 66 | 141 |
| 1986 | 81 | 128 | 201 |

### TABLE 2:
### Pediatric Hematology/Oncology Patients Followed — By Diagnosis

**A) ONCOLOGY PATIENTS**

| Diagnosis | On Therapy | Off Therapy | Total | Deaths |
|---|---|---|---|---|
| Leukemia — ALL | 32 | 26 | 58 | 2 |
| AML | 5 | 4 | 9 | 1 |
| Lymphoma | | | | |
| Non-Hodgkins | | | | |
| Burkitts | 1 | 2 | 3 | - |
| other | 5 | 6 | 11 | 2 |
| Hodgkins | 2 | 8 | 10 | - |
| Wilms | 5 | 13 | 18 | - |
| Neuroblastoma | 4 | 13 | 17 | - |
| Rhabdomyosarcoma | 3 | 7 | 10 | 2 |
| Ewings Sarcoma | 2 | 6 | 8 | 1 |
| Osteogenic Sarcoma | 3 | 2 | 5 | - |
| Hepatoblastoma | 1 | 1 | 2 | - |
| Brain | 7 | 13 | 20 | 2 |
| Retinoblastoma | 2 | 5 | 7 | - |
| Histiocytosis | 2 | 19 | 21 | - |
| Germ Cell | 2 | 1 | 3 | - |
| Melanoma | - | 1 | 1 | - |
| Neuroectodermal tumor | 1 | 1 | 2 | - |
| Sarcoma | 2 | - | 2 | - |
| Eosinophilic granuloma | - | 1 | 1 | - |
| Fibromatoma | 2 | 1 | 2 | - |
| TOTAL | 81 | 128 | 201 | 11 |

### B) HEMATOLOGY PATIENTS

| | |
|---|---|
| Various Severe Anemias and Red Blood Cell Defects | 27 |
| Idiopathic Thrombocytopenia Purpura | 15 |
| Neutropenia | 2 |
| Children with various bleeding tendencies including von Willebrand's disease and platelet function defects | 200 |
| Miscellaneous | 6 |
| **TOTAL** | **270** |

## TABLE 3
## Outpatients Seen in the Pediatric Hematology-Oncology Clinic

| Visits | New | Follow-up | Total Visits Requiring Physician Participation | Nursing Chemotherapy | Total |
|---|---|---|---|---|---|
| 1978 | 126 | 1,560 | 1,756 | 347 | 2,203 |
| 1979 | 136 | 1,742 | 1,859 | 361 | 2,243 |
| 1980 | 107 | 1,584 | 1,688 | 675 | 2,363 |
| 1981 | 91 | 1,631 | 1,728 | 523 | 2,251 |
| 1982 | 149 | 1,858 | 2,007 | 885 | 2,892 |
| 1983 | 203 | 1,723 | 1,929 | 842 | 2,768 |
| 1984 | 197 | 1,943 | 2,140 | 1,202 | 3,342 |
| 1985 | 204 | 1,889 | 1,093 | 1,286 | 3,379 |
| 1986* | 209 | 2,015 | 2,224 | 1,847 | 4,071 |

*Numbers shown for 1986 are estimates on data to the end of October for visits requiring physician participation and to the end of November for nursing chemotherapy visits.

### EDUCATION

The Section is fully approved for sub-specialty training by the Royal College of Physicians and Surgeons of Canada, and as a Section of the Department of Pediatrics, University of Manitoba, the teaching and educational programs of the Foundation for medical personnel include:

(a) Training of career pediatric oncologists/hematologists in order to permit them to pick up academic positions and assume careers of clinical practice, teaching and research. All candidates must conform to university entrance requirements for post graduate medical trainees and must have completed their core general pediatric training.

(b) The exposure of other oncology trainees (internal medicine, surgery) to the pediatric oncology patient.

(c) The provision for general pediatric residents of sufficient and appropriate exposure to hematology and oncology.

(d) The training of basic scientists in research encompassed within the discipline of pediatric hematology/oncology.

The Pediatric Section also participates in a formal elective program for students from the University of Manitoba School of Nursing.

The participation of the nurse, social worker, teachers, play co-ordinator and parents in education of their colleagues, the patients and their families has been discussed previously.

## RESEARCH

The Section actively supports clinical investigation aimed at current clinical problems in pediatric hematology/oncology and in the development of long term basic research. Just over $350,000 in grant and external funds was received by the various Section members for studies in 1986.

On-going clinical investigation and basic research in which the Section is participating at the present time:

1. Children's Cancer Study Group: Affiliated member since 1978. All new patients are registered with CCSG and approximately 85% of patients are on study protocols. A. J. Bishop, N. Kobrinsky, S. Israels, M. Schroeder.
2. Research, education and patient care within a Hemophilia Agency. N. Kobrinsky. (Manitoba Chapter of the Canadian Hemophilia Society).
3. The antenatal treatment of erythroblastosis fetalis by maternal administration of high dose intravenous gamma globulin. N. Kobrinsky, J. Bowman, A. J. Bishop. (Children's Hospital Research Foundation and the Manitoba Medical Services Foundation).
4. The role of DDAVP in decreasing blood loss in children undergoing spinal fusion surgery. N. L. Kobrinsky, R. M. Letts, L. Patel, M. Cheang, E. Israels and R. Monson.
5. Naloxone increases nausea and vomiting associated with cancer chemotherapy. N. L. Kobrinsky, P. Pruden, M. Cheang, M. Tenenbein and M. Levitt.
6. VP-16-213 and Hyperomolar sugar for the treatment of recurrent brain tumors. N. L. Kobrinsky, P. Pruden and L. Jonasson.
7. Studies on the Contractile Activity of Platelets. S. J. Israels.
8. The development and evaluation of reentry programs for children with cancer. Joyce Wright.
9. Studies of platelets, coagulation proteins and bleeding disorders. J. Gerrard, E. Israels, S. Israels (Children's Hospital Research Foundation, Medical Research Council).
10. The balance of thromboxane and prostacyclin in cardiovascular disease. J. Gerrard. (Canadian Heart Foundation).
11. Basic studies of platelets, natural killer cells and malignancies. J. Gerrard. (National Cancer Institute and the Medical Research Council of Canada).
12. HLA and disease. M. L. Schroeder.

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# GYNECOLOGIC ONCOLOGY

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**NURSING STAFF:**

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**NURSING AIDES:**

I. DeSousa, G. Harvey

# SECTION OF GYNECOLOGIC ONCOLOGY

## ORGANIZATION

The Section of Gynecologic Oncology is represented at the Manitoba Cancer Treatment & Research Foundation as well as at the St. Boniface Oncology Unit at the Health Sciences Centre and St. Boniface General Hospital. Members belong to the Section of Gynecologic Oncology of the Department of Obstetrics & Reproductive Sciences of the Faculty of Medicine. Clinics are held four one-half days weekly at the Manitoba Cancer Treatment and Research Foundation and three one-half days at the St. Boniface Oncology Unit. Close liaison is maintained with the Radiotherapy and Medical Oncology Divisions as well as urologic and surgical oncologists at both institutions. Referred patients are seen at both Oncology units and appropriate consultations, if needed, with other divisions. Hospital admissions are at the Women's Hospital or at St. Boniface Hospital. An Oncology Unit as well as a high-dependency area and a dedicated in-patient chemotherapy nurse is available at the Women's Hospital with similar facilities at St. Boniface Hospital on the Gynecology Service.

## TEACHING

Various levels of teaching are offered by the Gynecologic Oncology Service. A two-year postgraduate Fellowship Program was established in 1981. Currently the Program has one Fellow, with new Fellows already accepted for 1987-89. Dr. Jill Nation finished in 1986 and will join the Section of Gynecologic Oncology at the University of Calgary. Dr. John Mazurka entered a two year Fellowship in July, 1985.

Residents in their third and fourth year rotate through the Section for three month rotations as part of their training in the Department of Obstetrics, Gynecology & Reproductive Sciences. Tumor Conferences are held weekly at the Women's Hospital and St. Boniface Hospital with much appreciated pathology backup by Dr. M. Paraskevas and by Dr. G. Vadas. Reviews of current subjects in Gynecologic Oncology or pertinent clinical cases are presented for all residents, medical students, interns and staff.

The Section is responsible for chemotherapy as well as surgery. Bowel as well as urinary complications as they relate to gynecologic malignancy or its treatment complications are handled at both teaching hospitals. Full support is available from all subspecialty areas, including T.P.N., infectious disease, surgery, urology and physiotherapy. Full access to medical workers, chaplaincy service, pharmacy, occupational therapy and dietetics is available and a weekly nursing conference with all support staff represented is held. Slightly less than 1,000 in-patients were admitted in 1984 at both the Women's Hospital and St. Boniface Hospital units.

## CLINICAL INVESTIGATION

The Section is active in the N.C.I.C. Ovarian Cancer Protocols, both at the level of the writing committee and patient treatment. Currently patients with ovarian cancer are entered into OV6, OV7 or OV8 protocols.

Other interests of the Section include:

a) Surgical staging and endometrial carcinoma with an eight year review of the Manitoba Cancer Treatment & Research Foundation's experience.
b) Place of second look laparotomy in cancer of the ovary.
c) Chemotherapy treatment of ovarian sarcomas.
d) Frequency of cervical cytology.
e) Colposcopy in preinvasive cervical lesions and the use of laser in cervical, vaginal and vulvar preinvasive disease.
f) The role of staging laparotomy in early ovarian cancer.
g) The role of chemotherapy in ovarian carcinoma of low malignant potential.

## SECTION OF GYNECOLOGIC ONCOLOGY STATISTICS

### Manitoba Cancer Treatment & Research Foundation and St. Boniface Oncology Clinic

| | New Patients | Follow-up Visits | Total Patient Visits |
|---|---|---|---|
| 1985 | 423 | 3,781 | 4,204 |
| 1986 | 380 | 3,665 | 4,045 |

**Hospital Admissions — 1985**

| | Health Sciences Centre | St. Boniface General Hospital | Total |
|---|---|---|---|
| Surgical | 341 | 85 | 426 |
| Non-surgical | 450 | 231 | 681 |
| **Total** | **791** | **316** | **1,107** |

## PRESENTATIONS

Early Diagnosis and Management of Endometrial Carcinoma. Modern Use of Second Look Laparotomy. University of Laval, Quebec City. G. Krepart, November 1986.

Chemotherapy During Pregnancy. Canadian Society Gynecologic Oncologists. Tarpin Springs, Florida. G. Krepart, February 1986.

Radiation Bowel Complications. Forth International Conference on Gynecologic Malignancies. San Francisco, California. G. Krepart, May 1986.

Laser in Gynecology. Professional Development Days Society of OB-GYN of Canada. Winnipeg. R. Lotocki, March 1986.

Laser Surgery — N.A.C.O.G. Winnipeg, R. Lotocki, September 1986.

Diagnosis of Precancerous Lesions Society of OB-GYN of Canada Workshop — Charlottetown, P.E.I. R. Lotocki, June 1986.

## PUBLICATIONS

Helewa, M., Krepart, G. V., Lotocki, R. Staging Laparotomy in Early Epithelial Ovarian Cancer. Am. J. OB-GYN 154:280-286, 1986.

Krepart, G. V., Vigeant, J. L. Ovarian Carcinoma SOGC Bulletin Vol. 8, 2:23, 1986.

Krepart, G. V., Lotocki, R. J. Chemotherapy During Pregnancy In Cancer In Pregnancy Futura Publishing Co. Kisco, N.Y. Chapter 4, 69-88, 1986.

Nation, J., Krepart, G. V. Ovarian Carcinoma of Low Malignant Potential: Staging and Treatment. Am. J. OB—GYN 154:290-297, 1986.

## ONCOLOGY UNIT
## St. Boniface General Hospital

**Oncology Services Director:**
to 01 September 1986 — B. H. Weinerman, M.D., F.R.C.P.(C)
from 01 September 1986 — H. Schipper, B.A.Sc., M.D., F.R.C.P.(C) — Acting

**Head Nurse** — A. Meekison, R.N.

### RADIATION ONCOLOGY

**Radiotherapist** — E. Baral, M.D., from 01 September 1986.
**Radiation Technologists** — G. Ogilvie, R.N., R.T.T. — Senior Nurse, S. Hutton, R.N., R.T.T., S. Sharpe, R.T.T.
**Clinic Nurses** — B. Lucko, R.N., R. Olson, R.N., R.T.T.

### MEDICAL ONCOLOGY

**Physicians** — E. Bow, M.D., M.Sc., D.Bact., F.R.C.P.(C).
J. Foerster, B.Sc. (Med.), M.D., F.R.C.P.(C).
H. Schipper, B.A.Sc., M.D., F.R.C.P.(C).
A. M. Shojania, M.D., F.R.C.P.(C).
B. H. Weinerman, M.D., F.R.C.P.(C).
**Nursing Staff** — E. Bebchuk, R.N., Nurse Practitioner, B. Scott, R.N. — Assistant Head Nurse, D. Self, R.N., I. Lemoine, R.N., A. Acheson, R.N.
**Secretarial Staff** — D. McLellan, B. Scott, K. DeCosse.

**Support Staff** — C. Berthelette, Senior Ward Clerk, R. Provitina, Senior Ward Clerk, H. Lucy, NA II, E. Denewith, NA I.
**Protocols** — L. A. Love, Protocol Data Manager

### OUTREACH

**Director** — H. Schipper, B.A.Sc., M.D., F.R.C.P.(C).
**Coordinator** — A. Nemecek, R.N., B.A.
**Pharmacist** — D. Dickoff, B.Sc., B.Pharm.
**Data Manager** — G. Charlo, HRT.
**Secretarial Staff** — K. Decosse, B. Cesmystruk

### SOCIAL WORK

J. Taylor-Brown, B.S.W., F. Nelson, M.S.W.

## ONCOLOGY UNIT — ST. BONIFACE GENERAL HOSPITAL

The St. Boniface Hospital Oncology Unit is a fully integrated joint program of the Manitoba Cancer Treatment and Research Foundation and the St. Boniface General Hospital. The original unit, a radiation oncology program, rented an area in the St. Boniface General Hospital and under the guidance of senior radiotherapist Dr. James Bennett, provided radiation therapy services to referred patients for thirty years.

In 1973, with the introduction of a formal chemotherapy program at the hospital, and with the subsequent growth of that program, a different cooperative effort between the St. Boniface Hospital and the Foundation began to evolve. This arose because of the increased demands for chemotherapy and the need for inpatient treatment. In 1975, a joint program established an outpatient oncology clinic in the ambulatory care facility of the hospital.

The eventual need for expanded outpatient facilities and the requirement for a new cobalt unit resulted in the planning of a new outpatient oncology facility which had its sod turning ceremony in July of 1982, and its official opening April 1984. The new six million dollar wing of St. Boniface General Hospital became the site of a modern cancer diagnostic and treatment centre. The three-storey annex is adjacent to the x-ray department and thereby places the cancer diagnostic and treatment facility adjacent to radiological and ultrasound facilities. The facility increases the efficiency of the two oncology areas by physically joining them and thereby better utilizing nursing and other support personnel. A joint nursing coordinator, as supervisor of all nursing positions serves to cement the entire oncology area and also adds a link to the inpatient oncology unit. This latter unit was opened in September 1984 as a forerunner to an expanded unit which will subsequently support intensively treated patients.

For both treatment and research, oncology is an interdisciplinary specialty. Treatments are frequently multi-modal. The requirement for co-ordinated prospective patient management is becoming absolute. Thus, as part of its continuing evolution, the St. Boniface Hospital Unit continues to move toward a co-ordinated multi-specialty program. The combined oncology/pathology conference serves in a diagnostic and teaching role, illustrating the necessary dialogue between clinician and pathologist. With the arrival of a new senior radiotherapist, the first integrated radiotherapy/chemotherapy clinic at St. Boniface was established. Eventually most outpatient clinics will be conjointly staffed, as part of an overall integration plan. With certain limited exceptions, where additional expertise or equipment must be assembled (i.e. a breast diagnostic clinic), the St Boniface program is committed to the concept of general oncology within a community of subspecialty interests. Thus outpatient clinics will reflect the patient demography of the St. Boniface Hospital catchment area.

This program evolution will also extend to the inpatient service. This service is to be highly protocol oriented, efficient and compassionate in keeping with a commitment to uncompromised care and quality research during a period of substantial fiscal constraint. A mature, highly trained and stable nursing staff will form the core of such a unit. Strong collaborative links with professional medical departments, Pharmacy, Social Work, The Outreach Program, Pastoral Care, Home Care, Dietetics and the Palliative Care Unit round out the interface between the Manitoba Cancer Foundation program and St. Boniface Hospital.

## Teaching

The Oncology Program is integrated with the University of Manitoba Faculty of Medicine for graduate and undergraduate training. It is accredited for subspecialty training in Medical and Radiation Oncology with the Royal College of Physicians and Surgeons of Canda.

Training roles at St. Boniface Hospital are largely consultative. Emphasis is currently placed on outpatient experience and the evaluation of new patients in an academic trials oriented setting. Specific programs available to trainees include:

1. Pathology/Oncology conference
2. Haematomorphology
3. Coagulation laboratory experience
4. Weekly "walk-around" service rounds.

In addition, as part of the MCTRF Oncology Program trainees are full participants in tutorial sessions, research and teaching rounds and individualized research projects.

## Research

Research based at the St. Boniface Unit is largely clinical. The following are broadly described investigative areas where programs are currently underway:

1. Adjuvant chemotherapy and radiotherapy trials in breast and colon cancer through the National Surgical Adjuvant Breast Program.
2. Clinical trials in lung cancer, lymphoma, hairy cell leukemia, colon cancer, renal carcinoma and testicular carcinoma in collaboration with the National Cancer Institute (Canada) Clinical Trials Program.
3. Phase II Investigational Drug Trials in collaboration with the National Cancer Institute (Canada).
4. Acute leukemias with particular focus on induction methodologies.
5. Strategies of infection prevention and treatment in neutropenic cancer patients.
6. Impact of antimicrobial use on the endogenous microflora in cancer patients.
7. Quality of Life studies in cancer patients, including instrument development, strategies for trials design and interpretation, and the application of quality of life methodologies to contemporary clinical trials.
8. Evaluation of venous access devices in the management of cancer patients.

## Nursing

In accordance with the Aims and Missions of St. Boniface Hospital and in collaboration with our multidisciplinary team (Home Care, Social Work, Pastoral Care, Pharmacy), we strive to attain excellence in patient care. We are very pleased to welcome Elaine Delaveau, Dietitian, to our multidisciplinary team and with the support of the Nutrition Service Department have developed an Outpatient Oncology Nutrition Service Program.

Our patient activities have expanded to include a small pediatric population all of whom have alternate venous access devices and an outpatient clinical service for Human Immunodeficiency Virus (HIV) infected individuals.

May of 1986 marked the publication of our Patient Handbook made possible through a generous donation from the East Kildonan Lioness Club. The Handbook was developed by the Department of Social Work in collaboration with the Oncology Unit and they many cancer patients who shared their experiences and gave their suggestions regarding what information would be helpful to them.

Our Outpatient Oncology Clinic Information Day is now provided on an ongoing basis to health care professionals within the hospital and the community. The inservice sessions involve the many disciplines which comprise our unit and provide an overview of cancer care and internal and external support systems for cancer patients.

The Oncology Unit continues this year its many collaborative activities with:

i. Masters Program students (thesis projects).
ii. Public Relations Department (Organization of information tours).
iii. University of Manitoba, School of Nursing (senior elective experience).
iv. Nursing Excellence Day (presentation on Outreach with Anne Nemecek, Outreach Coordinator.
v. In-hospital Continuing Education — (inservice sessions).

We continue to liase closely with those areas in hospital which administer the majority of chemotherapy treatments (3B Gynecology, 5B-Medicine) and have provided a clinical of practicum in chemotherapy administration for two additional nurses from 5B. We have also been instrumental in providing inservice sessions and clinical experience for these two areas and 8A Pediatrics in the care and access of subcutaneous ports.

Plans are in progress to establish a regularly scheduled tour of Oncology for new patients and their families in order to facilitate the transition from hospital to clinic. In addition this committee will also begin the ground work of establishing a patient information library.

We continue to place a strong emphasis on continuing education for staff members. In addition to regularly scheduled rounds (Oncology/Pathology Rounds, Psychosocial Rounds, "Dr. Bow" Rounds), staff members have attended several day long local educational programs.

Our commitment to the "Orientation to Cancer Nursing" sessions continues from intensive committee involvement to con-jointly providing a clinical practicum for three Outreach Nurses.

## SOCIAL WORK

**TABLE I — Summary of Social Work Activity in Oncology**
(excludes Gynecology Oncology, AIDS, Radiotherapy)

| Year | Files Opened | Avg. Number Opened/Mo. | Serv. Hrs. to Pts. | Serv. hrs to Prog. |
|---|---|---|---|---|
| 1984 (Apr-Dec*) | 43 | 4.8 | 685 | 313 |
| 1985 | 97 | 8.1 | 1146 | 344 |
| 1986 | 92 | 7.7 | 756 | 350 |
| % change | -5.2 | | -34.0 | +1.7 |

*Pro-rated over 12 months.

### TABLE II — Reason for Referral to Social Work
(Excludes Gynecology Oncology, AIDS, Radiotherapy)

| Referral Reason | N | % |
|---|---|---|
| Adjustment to Illness | 36 | 39.1 |
| Sexuality | 14 | 15.2 |
| Financial | 11 | 12.0 |
| Depression | 6 | 6.5 |
| Family Relationships | 6 | 6.5 |
| Social Work Evaluation | 5 | 5.4 |
| Marital Relationship | 4 | 4.4 |
| Anxiety | 4 | 4.4 |
| Behaviour Problems | 1 | 1.1 |
| Decision Making | 1 | 1.1 |
| Transportation | 1 | 1.1 |
| Placement | 1 | 1.1 |
| Missing | 2 | 2.2 |
| **TOTAL:** | **92** | **100** |

**Patient Care and Education**

The Department of Social Work at St. Boniface General Hospital continued to maintain a solid presence in the Oncology Unit during 1986, while still limiting participation in Gyn-Oncology and Radiotherapy because of insufficient manpower. The Department sees patients on referral most often after discussion with staff or at rounds. The Department believes its professional resources are most efficiently utilized by active and ongoing training of medical/nursing staff in appropriately identifying patients requiring clinical social work.

Table 1 summarizes our work in Oncology during 1986. The effect of a major staffing change is clearly reflected in the above statistics, where the average patient hours per month fell from 101 for January to May (up from 95.5 hours in 1985) to an average of 36 hours for the period June to December. While patient service hours declined from last year, service to the program in terms of rounds, education, planning and research was maintained.

Table 2 shows the Reason for Referral for the 92 files opened in Oncology. Just under 40% of the referrals were to assist patients and family members adjusting to the impact of their disease, diagnosis, and/or treatment. Sexuality issues accounted for 15% of all referrals, largely resulting from a pilot project undertaken during the year. An additional 22% of the referrals were for anxiety, depression and marital and family relationship problems, while 12% of the referrals were for financial concerns and a combination of other reasons as noted above.

The Department continued its monthly Cancer Patient Support Group meeting on the fourth Tuesday of each month. Attendance ranged from 10 to 30 patients and families.

The Department of Social Work also played an active part in the Canadian Cancer Society activities during the year. Locally, this included planning and participating in the Society's conference for volunteer visitors entitled "Nearing the End of Life's Journey", sitting on the local Service to Patients Committee, and regularly participating in the Society's training program for volunteers. Nationally, the Department participated in the development of a pain control booklet for patients entitled, "Pain Relief: Information for People with Cancer and Their Families", a joint project of the Canadian Cancer Society and Health & Welfare Canada.

### Acquired Immune Deficiency Syndrome

The appearance in 1986 of HIV positive, ARC and AIDS patients at St. Boniface General Hospital had a significant impact on the Department of Social Work. Early reviews suggest these patients place extraordinary demands on psychosocial resources because of the nature of their illness and its psychosocial ramifications. In June 1986, the Department began to formally record its activities with these patients. Data for those months indicate on average that about 33 hours per month of service to and on behalf of AIDS patients, and an additional 25 hours per month going to various planning activities. It is difficult to know at this point what the long range impact will be; however, the experience in the United States and current projections are most disconcerting and will provide distinct staffing challenges for us. Some community programs are developing, but they will likely still turn to the hospital for support.

### Community Education and Research

The Department continued active participation in the formation of the Canadian Association of Psychosocial Oncology, a national professional association dedicated to psychosocial issues in Oncology. We also continued to participate in the Orientation to Cancer Nursing. Among other programs were presentations to Outreach pharmacists, the Fall 1986 conference entitled 'Many Faces of Grief', involvement with the Oncology Unit Information Day, and the training of volunteers. A B.S.W. student from the University of Manitoba did a clinical practicum in Oncology.

## OUTREACH PROGRAM

1986 has been a very busy year for Outreach. Government funding allowed for the hiring of an Outreach pharmacist and data manager, as well as two computer systems analysts. The Assistant Directors of both Records & Registry and Information Services departments work closely with these Outreach administrative staff as part of the Outreach Team.

The team established program goals in early 1986 and began implementation.

There are three overall program goals:

1. To develop a program whereby cancer patients can safely receive chemotherapy and follow-up in or near their own communities.
2. To promote the highest level of knowledge and skills in the health care professionals involved with cancer treatment in the Outreach Centers.
3. To establish a Province-wide cancer patient management system.

In order to expand the program throughout the province, specific criteria for Outreach Centre selection, physician selection and patient entry have been developed.

**Facility Selection**

Those facilities designated as Outreach Centres must meet the following criteria:

- An estimated minimum patient accrual of 25 patients per year per clinic.
- A local medical association able to select two of its membership to assume responsibility for local administration of the program.
- A local hospital which has the physical space available to provide the clinic setting.
- Laboratory facilities able to provide the basic hematology and biochemistry necessary for safe administration of chemotherapeutic agents.
- Pharmacy facilities to supply chemotherapeutic agents and act as a clinical resource.
- The ability to meet standards of pharmacy, laboratory, nursing and medical care.

**Patient Selection**

A patient is eligible to receive treatment as an Outreach Center subject to the following criteria.

- He/she resides in an Outreach catchment area.
- He/she has treatment planned by a specialist oncologist through the Manitoba Cancer Foundation.
- He/she is under the care of a designated Outreach physician.
- He/she receives treatment and follow-up in the designated Outreach Center by Outreach physicians and nurses.

In April 1986 began the move toward expanding the program province-wide. The opening of the new Outreach Center in Morden/Winkler in 1986 began the move toward expansion of the program and not only made Outreach available to the South-central part of the province, but demonstrated the capability of two communities to collaborate on one service.

A prime focus of the Outreach program this year has been to broaden the oncology knowledge base of staff in Outreach Centers. Staff have been encouraged to attend "Orientation to Cancer Nursing" workshops offered by the Manitoba Cancer Treatment and Research Foundation. This year eight nurses and three pharmacists have attended. Three new nurses were given three week classroom and clinical experience in administering chemotherapy. Three physicians were oriented to Outreach. Dr. R. Decker from Dauphin Outreach received one of the first Stephen Fonyo Fellowships from the Canadian Cancer Society, which enabled him to complete a two-month oncology residency.

Our first Outreach workshop was held in April 1986. Forty Outreach-associated health professionals attended a three-day symposium, one-half day of which was devoted to Outreach. The Outreach manual was introduced outlining the philosophy, goals and administrative policies and procedures of the program. Pharmacists attended a concurrent workshop organized by the Outreach Pharmacist. Health record practitioners in cash Outreach Center are now included in the Outreach Program. A concurrent session for health record practitioners organized by Ms. Gloria Hanson, Assistant Director, Records & Registry was held during the April symposium.

A "Lending Library" of resource cancer information, books and videos, has been started for Outreach with support from the Canadian Cancer Society.

One of the overall objectives of the Outreach Program for 1986 was to promote the program, not only in Manitoba, but in other areas. Several inservice sessions have been given to achieve this end. The Outreach Team has also published a patient information brochure.

Outreach is an exciting concept for health care. Cancer, now considered a chronic disease, often entails long periods of treatment and follow-up. Patients want the security of family, friends and familiar surroundings when they are undergoing treatment. The Outreach Chemotherapy program has helped many patients achieve this.

## STATISTICS

### TABLE I — Medical Oncology Statistics, St. Boniface General Hospital

| | New Patients | Follow-up Visits | Total Physician Visits | No. of Patient Treatments | Procedures |
|---|---|---|---|---|---|
| 1981 | 224 | 2,242 | 2,466 | 2,326 | N.R. |
| 1982 | 306 | 2,580 | 2,886 | 2,152 | N.R. |
| 1983 | 377 | 4,257 | 4,694 | 3,753 | 3,399 |
| 1984 | 395 | 4,141 | 4,536 | 2,699 | 4,984 |
| 1985 | 492 | 4,656 | 5,148 | 2,475 | 9,483 |
| 1986 | 336 | 4,632 | 4,968 | 1,783 | 8,973 |

### TABLE II — Protocol Statistics, St. Boniface General Hospital — 1986

| | On Study From End of | | New Patients Entering During | | Off Study During | | Patients on Active Follow-up End of | |
|---|---|---|---|---|---|---|---|---|
| GROUP | 1985 | 1986 | 1985 | 1986 | 1985 | 1986 | 1985 | 1986 |
| NCIC | 63 | 82 | 29 | 14 | 9 | 13 | 82 | 83 |
| NSABP | 98 | 115 | 21 | 9 | 4 | 5 | 115 | 119 |
| LOCAL & OTHERS | 25 | 24 | 14 | 35 | 15 | 20 | 24 | 39 |
| TOTALS | 186 | 221 | 63 | 58 | 28 | 38 | 221 | 241 |

## PUBLICATIONS

***Dr. Edward Baral***

Rotstein, S., Blomgren, H., Petrini, B., Wasserman, J. and Baral, E.: Long-term effects on the immune system following local radiation therapy for breast cancer. III. Changes of spontaneous and lectin dependent cellular cytoxicity. Anticancer Research, 6:113-118, 1986.

Rotstein, S., Blomgren, H., Petrini, B., Wasserman, J. and Baral, E.: Long-term effects on the immune system following local radiation therapy for breast cancer. IV.

Proliferative responses and induction of suppressor activity of the blood lymphocyte population. Radiotherapy and Oncology. Accepted for publication.

Wasserman, J., Wallgren, A., Blomgren, H., Baral, E. and Petrini, B.: Prognostic relevance of post-radiation lymphocyte reactivity in breast cancer patients. Cancer, **58,** 238-251, 1986.

Azavedo, E., Baral, E., and Skoog, L.: Immunohistochemical analysis of estrogen receptors in cells obtained by fine needle aspiration from human mammary carcinoma. Anticancer Research, **6**:263-266, 1986.

Rotstein, S., Blomgren, H., Baral, E., Lax, J., Israelsson, A., Nilsson, B., Petrini, B., and Wasserman, J.: Incidence of infectious symptoms after radiotherapy for breast cancer. Acta Radiologica. Submitted 1986.

Baral, E., Blomgren, H., Wasserman, J., Rotstein, S. and von Stedingk, L-V.: Effect of tamoxifen on Pokeweek mitogen stimulated immunoglobulin secretion in vitro. Journal of Clinical and Laboratory Immunology, Accepted, 1986.

Baral, E., and Vanky, F.: Effect of Tamoxifen on the cellmediated auto-tumor lysis. J. Clin. Lab. Immunol. Accepted, 1986.

Baral, E., Glas, U., Rutqvist, L-E., Skoog, L.: Adjuvant therapy in postmenopausal patients with operable breast cancer. In: "Reviews on Endocrine-related Cancer" by Pharmaceuticals Division of ICI. 1986.

Nylen, U., Baral, E., Svane, G. and Rutqvist, L-E: Low dose doxorubicin in treatment of metastatic breast cancer. Cancer Treatment Reports. Submitted, 1986.

Rutqvist, L-E., Baral, E., Cedermark, B., Glas, U., Somell, A., Theve, N-O, Friberg, S., Askergren, J., Skoog, L., Wallgren, A.: The Stockholm Trial on Adjuvant Tamoxifen in Early Breast Cancer. Cancer Treatment Reports. Submitted, 1986.

### *Dr. Brian Weinerman*

Weinerman, B. H., Eisenhauer, E. A., Besner, J. G., Coppin, C. N., Stewart, D., Band, P.: A Phase II Study of Lonidamine in Patients with Metastatic Renal Cell Carcinoma. Published Cancer Treatment Reports **70,** No. 6, June 1986.

Weinerman, B. H., Orr, K., Rogers, A., Lu, L.: The Effect of Diagnostic Irradiation on the Development of Ca of Colon in the Mouse. Journal of Surgical Oncology **31**:163-165 (1986).

Eisenhouer, E. A., Weinerman, B. H., Kerr, I., Quirt, I.: Toxicity of Oral N-Methylformamide in Three Phase II Trials. (A report from the NCI Canada Clinical Trials Group). Cancer Treatment Reports **70,** No. 7, July 1986.

### *Dr. A. M. Shojania*

Shojania, A. M., Grewar, D.: Hypoprothrombinemic hemorrhage due to cholestryramine therapy. Can. Med. Assoc. J. **134,** 609, 1986.

Eshghabadi, M., Shojania, A. M., and Carr, I.: Isolated granulocytic sarcoma: report of a case and review of the literature. J. Clin. Oncol. **4,** 912, 1986.

Riddel, S. R. and Shojania, A. M.: Disseminated intravascular coagulation in lupus erythematousus responding to prednisone. Am. J. Hematol. 23, 65, 1986.

***Dr. Harvey Schipper***

Schipper, H.: Quality of Life and the Cuddly Koala Bear. Humane Medicine, 2, 88-89, November 1986.

Fisher, B., Brown, A., Wolmark, N., Redmond, C., Wickerham, D., Dimitrov, N., Legault-Poisson, S., Schipper, H., Prager, D., and Other NSABP Investigators: The Benefits of Prolonging Tamoxifen Therapy for Primary Breast Cancer: Findings from an NSABP Clinical Trial. Submitted Annals of Internal Medicine.

Schipper, H., Levitt, M.: Quality of Life in Cancer Trials: What Is It? Why Measure It? Proceedings of the International Workshop on Quality of Life Assessment and Cancer Treatment, Milan, Italy, December 1986.

## ABSTRACTS AND PRESENTATIONS

***Dr. A. M. Shojania***

Shojania, A. M., Orr, K., and Meilleur, G.: The effects of vital dyes in coagulation and immunological reactions. Pediatric Res. 20:287A, 1986.

***Dr. H. Schipper***

Linford, J., Shalev, S., Bews, J., Brown, R., Schipper, H.: Development of a tissue-equivalent phantom for diaphanography. American Association of Physicists in Medicine, Twenty-eighth Annual Meeting, Lexington, Kentucky, August 3-7, 1986.

Schipper, H.: Rehabilitation and Human Values: Quality of Life. 14th International Cancer Congress, Budapest, Hungary, August, 1986.

Levitt, M., Schipper, H.: Measuring Quality of Life in Cancer Patients, 'FLIC'. 6th World Congress on Care of the Terminally Ill, Montreal, September 27, 1986.

***Dr. B. Weinerman***

Band, P. R., Weinerman, B., Eisenhouer, E., Murray, N.: Cancer Control Agency of British Columbia, Vancouver, B.C., St. Boniface Hospital, Winnipeg, Manitoba: Lonidamine (LDM), A New Anticancer Agent: Overview of Canadian Trials. Submitted to 14th International Cancer Congress, Budapest, Hungary.

***Dr. E. Bow***

Bow, E. J., Rayner, E., Alsanuk, J., Louie, T. J.: A Comparative Trial of Norfloxin and Trimethoprin/Sulfamethoxazole for infection prophylaxis in patients with acute leukemia. Abstract #93 presented at the 4th International Symposum on Infections in the Immunocompromised host. Ronneby Brunn, Sweden, June 15-19, 1986.

Louie, T., Mandell, L., Feld, R., Chow, A., Robson, H., Bow, E., Miedzinski, L., Nicolle, L., Rachlis, A., Morisset, R. and Pater, J.: Multicenter Comparison of Aztreonam Plus Cloxacillin, Aztreonam Plus Tobramycin, or Moxalactam Plus Tobramycin as Empiric Therapy of Febrile Neutropenic Episodes. Abstract #157 presented at the 4th International Symposium on Infections in the Immunocompromised host. Ronneby Brunn, Sweden, June 15-19, 1986.

Bow, E. J., Chubb, H., Louie, T. J.: Synergism Among Six Empiric Antibiotic Regimens for Gram Positive Cocci Recovered from Neutropenic Patients Receiving Infection Prophylaxis. Abstract 163 presented at the 4th International Symposium on Infections in the Immunocompromised host. Ronneby Brunn, Sweden, June 15-19, 1986.

## MEDICAL PHYSICS

**ACTING DIRECTOR** — P. Dunscombe, Ph.D., F.C.C.P.M.

### PHYSICISTS

G. Froese, Ph.D., F.C.C.P.M.; W. Huda, Ph.D., F.C.C.P.M.; T. Lee, Ph.D., F.C.C.P.M.; R. Palser, Ph.D., F.C.C.P.M.; S. Shalev, Ph.D., M. Soubra, M.Sc., A. Sourkes, Ph.D., F.C.C.P.M.

### TREATMENT PLANNING/SIMULATION/DOSIMETRY

L. Bailey, R.T.(T), M. Carey, R.T.(T), B. Hintz, R.T.(T), M. Porth, R.T.(T), N. Saunders, R.T.(T), M. Stewart, R.T.(T) A.C.(T), K. Suderman, R.T.(T), O. Werner, R.T.(NM), C. Zeller, R.T.(T).

### MEDICAL DEVICES/MOULD ROOM

D. Bradley, T. Gaboury, R. Gallant, B. Griffiths, J. Legal, E. Maisey, R. Norton, A. Wolk

### NUCLEAR ELECTRONICS

V. Goertzen, M. Goldie, M. Hanuschuk, R. Shabaga, W. Stepaniuk

### RADIATION PROTECTION

R. Kowaluk, R.T.(R), C. Neduzak, R.T.(R), G. Philippot, R.T.(R), R. Ross, M.Sc., J. Sandeman, B.Sc., D. Wylie, B.Sc.

### RESEARCH

L. Bartel, B.Sc., S. Cosby, B.Sc., A. Davis, R. Ellis, Ph.D., E. Kettner, B.Sc., C. Shyka, B.Sc.

### GRADUATE STUDENTS

J. Bews, M.Sc., T. Constable, B.Sc., D. Lowe, B.Sc., Y. McFarlane, B.Sc., E. Papiez, B.Sc., G. Sandison, M.Sc., P. Therrien, B.Sc., A. Tsoukatos, M.Sc.

### SUMMER STUDENTS

C. Cormier, B. Karras, B.Sc., J. McLellan

### SECRETARIES

L. Beauchamp, T. Davidson, S. Finney, L. Juba, A. Scott

# 1. INTRODUCTION

1986 saw a continued expansion of activity in all areas of interest to the Department. The Medical Imaging Section has again been heavily involved in the evaluation, selection and acceptance testing of increasingly sophisticated diagnostic equipment. The major effort in this area in 1986 was participation in the purchase of three new Computed Tomography (CT) Scanners for the Province.

In Radiotherapy Physics, as documented below, several clinical procedures have been subjected to detailed scrutiny resulting in significant improvements to current practice. Equipment purchase has, for this Section too, been a significant component of the workload as the acquisition of both additional and replacement therapy equipment is receiving serious consideration.

The Radiation Protection Service, which is operated from the Department continues to provide the comprehensive response for which it is respected within the Province and nationally.

In Treatment Planning and Simulation the workload has maintained its increase as procedures become more complex. The addition of the reconditioned simulator at the St. Boniface unit represents a significant improvement in the service offered to patients but has brought with it the difficulty of scheduling time on three simulators with limited staff.

The Sections of Medical Devices and Nuclear Electronics carry the principal responsibilities for ensuring that both Radiotherapy and Nuclear Medicine equipment within the City functions reliably with minimal disruption to clinical schedules. This they have again succeeded in accomplishing in spite of the ever increasing workload.

Academic programs remain a vital area of the Department's activities. With the unique training and expertise of the staff within the Department a commitment to training programs is essential if an adequate supply of Medical Physicists, Radiotherapists, Radiologists and Technologists is to be ensured for the future.

1986 saw the election of five Physicists in the Department to Fellowship of the Canadian College of Physicists in Medicine. This status is achieved after successfully completing both a written examination and an oral examination conducted by eminent Medical Physicists from all over the country.

In spite of the heavy clinical responsibilities borne by the Department it has been possible to pursue some clinically oriented research and development projects. These are outlined in the sections that follow.

Finally, members of the Department continue to contribute to scientific and professional matters at the Provincial and National levels. Several staff hold offices in the Manitoba Association of Medical Radiation Technologists. In addition the Department is represented in the Medical and Biological Division of the Canadian Association of Physicists and on the Hyperthermia Committee of the American Association of Physicists.

## 2. CLINICAL SUPPORT

### RADIOTHERAPY PHYSICS

*G. Froese*

This Section has continued to provide physics support for radiotherapy in the areas of radiation dosimetry, brachytherapy, treatment planning and quality control of therapy machine performance and therapy procedures. Machine output is checked weekly with a Protea Beam Analyzer and these measurements are compared periodically with a standard calibration carried out according to the AAPM TG-21 protocol. Extensive measurements of output and field flatness were also performed after the repair of the Sagittaire linear accelerator and the output of the machine was adjusted to the standard level. Our dosimetry capabilities were considerably improved in 1986. A parallel plate ionization chamber was obtained for the purpose of measuring surface doses, and a polystyrene phantom with a film cassette has been introduced. The latter is conveniently used both for measurements with an ionization chamber and for film dosimetry. A method is now being developed to obtain the density distribution of the exposed film from the analysis by computer of a video-image of the film. The machine output for very small and for irregular electron fields has been studied to a large extent with film dosimetry. This project is described later in more detail. Studies of the dosimetric aspects of selected treatment procedures were also carried out: the treatment of mesothelioma (as detailed below), the treatment of breast and the treatment of central nervous system malignancies. The treatment of the breast has been improved by the design of a new wedge combined with a half-field block. The use of this wedge-block combination results in a lower dose to the lungs during treatment. The data for this wedge-block combination have been measured and entered into the computer so that the dose distribution for individual patients can now be precisely calculated.

At the present time it is necessary to obtain dose data for each new wedge from measurements made in a phantom. We have now investigated the dependence of the effective attenuation of lead as a function of lead thickness and field size. This information will make it possible to improve the computation in such a way that an accurate dose distribution can be calculated for a new wedge from the physical dimensions of the wedge.

In brachytherapy, the Department of Medical Physics has continued to serve as the custodian for the treatment sources. Treatment with iridium implants varies greatly from patient to patient and this Section has been involved to a great extent in the planning of the treatment and the procedures for insertion of the sources. A new personal shield has been designed and manufactured to minimize the dose received by the radiotherapist and physicist during the insertion of the sources.

The overhaul and modifications of the used simulator, which had been obtained for the St. Boniface unit, were completed in 1986. The facility was commissioned after complete acceptance testing of the equipment and is now the third such machine serving radiotherapy patients in Manitoba.

## MEDICAL IMAGING
*R. Palser*

During 1986 the Medical Imaging Section continued to provide a clinical service to Winnipeg Nuclear Medicine departments in the area of equipment purchase and optimum use, developmental research, radiation protection and teaching. In particular, the activities undertaken with the Department of Radiology at St. Boniface General Hospital and the Health Sciences Centre have continued to expand.

At the Health Sciences Centre Nuclear Medicine Section a Technicare large field of view gamma camera was purchased, installed and tested to verify that its performance was in accord with the manufacturer's specifications. The large rectangular detector of this device is ideally suited to the performance of bone and whole body diagnostic surveys and has considerably reduced the time required for these clinical procedures.

The Department of Nuclear Medicine at St. Boniface General Hospital is expanding to offer Single Photon Emission Computed Tomography (SPECT) procedures. The commercially available SPECT gamma cameras and associated computers were evaluated and recommendations regarding the purchase of a SPECT system made to the hospital.

Also, at St. Boniface General Hospital, a bone densitometry system for diagnosis and management of metabolic bone diseases, was purchased and installed, and is now in clinical operation.

During the year, the Province of Manitoba authorized the purchase of three Computed Tomography (CT) Scanners for installation in the Radiology Departments at Brandon General Hospital, Health Sciences Centre and St. Boniface College Hospital. The Section participated in preparation of the tender, evaluation of the technical aspects of the tender responses, conducting site visits and aiding the hospitals in specification of the scanner suites. When the equipment is installed next year, the Section will perform the acceptance tests to ensure compliance with the terms and specifications of the tender and will initiate the ongoing quality control of the equipment.

At St. Boniface General Hospital the Digital Vascular Imaging equipment acquired by the Department of Radiology was evaluated, acceptance tested and quality control procedures recommended to ensure its ongoing optimum performance.

We have continued involvement with both St. Boniface General Hospital and the Health Sciences Centre in the evaluation of Nuclear Magnetic Resonance (NMR) systems, a relatively new imaging modality making major contributions to the fields of tomographic section imaging and organ function imaging. To aid in the eventual acquisition of an NMR imaging system, the Section has assisted the hospitals in the specification of these machines, made site visits to several installations to evaluate technical aspects, and participated in a joint project with the hospitals and the Universities of Manitoba and Winnipeg. Several smaller projects related to equipment evaluation, purchase and clinical performance were also completed for various city hospitals during the year.

The Nuclear Medicine quality control program, which covers all clinically used gamma cameras, uptake probes, radiation monitoring equipment, well counters and some film processors, was continued in order to maintain long term optimal and stable operation of the equipment. Members of the section have been involved in monitoring quality assurance in the Departments of Radiology both at St. Boniface General Hospital and Health Sciences Centre.

In the areas of radiation protection and safety, members of the Section have remained active in providing services to the city hospitals and the Manitoba Cancer Treatment and Research Foundation via the Clinical Isotope Committee and the Therapy Sources Committee.

## TREATMENT PLANNING/SIMULATION

*M. Stewart*

The treatment planning and simulator section is responsible for providing technical support for the individualized design and implementaton of treatment plans for the treatment of cancer with radiotherapy.

A simulator is an x-ray machine used for the localization of tumor volumes and marking of treatment fields on patients. During the year, the AECL Therasim was used full-time. A Picker simulator was installed at St. Boniface and was ready for use in April 1986. The MCF Picker Simulator and the SBGH Picker Simulator together were used approximately 4 days per week. Prior to April, marker films were taken on the St. Boniface patients who could not travel to MCF for simulation. The total number of simulations performed at MCF was 2,836. The total number of simulations/markers done at SBGH was 353. The combined total is 3,189. This represents a decrease of 2% over last year.

The number of patients requiring the services of treatment planning was 1,144, which is an increase of 10% over 1985. The procedures in this area include: design of cerrobend blocks for field shaping (1,021 procedures — an increase of 13% over 1985); the design of lead compensators to achieve uniform dose distribution (110 procedures — a reduction of 27% over 1985); the design of treatment field arrangements and specific dose calculations (343 procedures — an increase of 25% over 1985). 68 clinical TLD measurements were performed (a decrease of 27% over 1985); 764 port films were taken on the treatment machines to verify the accuracy of patient positioning (an increase of 46% over 1985). Port films have been taken routinely on irregular fields in the head and neck region and irregular fields used for Hodgkin's Disease patients treated with the mantle and inverted Y techniques during 1986. In the latter part of the year, selected prostate patients also had port films.

With the new CT Scanner installed at the Health Sciences Centre it is expected that there will be an increased workload in CT planning.

## MEDICAL DEVICES

*J. Legal*

Much of the past year has been spent repairing and upgrading ageing equipment. Starting in 1985 our Section in cooperation with Nuclear Electronics undertook to rebuild a worn and initially obsolete simulator being discarded by the Cross Cancer Centre in Edmonton. The result on its completion in 1986, is a fine clinical machine which performs considerably better than when it was new and will probably last longer than its age to date. Improvements include a modern, new carbon fibre couch top, more robust and safer drives, a laser patient alignment system and several custom designed accessories to make it compatible with our treatment machines. It is estimated that this exercise has saved the Province at least $200,000.00.

Both the Linac 4 MV and the Sagittaire required major mechanical repairs. The beam defining collimators of these linear accelerators were badly worn and necessitated complete overhauls. The fabrication of critical parts no longer available from the manufacturers will extend the life of these old units considerably and beam defining accuracy is once again as good as new.

Growing concern over excess radiation to the gonads of men undergoing radiotherapy in adjacent sites prompted a request for specialized shielding. The result was the construction of two devices. One is a self contained unit that rests on the surface of the treatment couch. It is designed to articulate through several degrees making it possible to shield the gonads with 40 mm. of lead where it is most crucial. The other is a simpler device that has been incorporated into the structure of the Sagittaire couch. It can be readily positioned adjacent to the field when treating through the couch from below.

A challenging project begun in 1985 and recently completed at the Children's Hospital cardiology unit was an articulating infant cradle. This radiotranslucent cradle was designed to facilitate the critical positioning of pediatric patients undergoing heart catheter procedures while being monitored by x-ray imaging techniques.

Other smaller projects successfully completed by the Medical Devices Section include the following:

Instruments to aid in proctology procedures which will serve as prototypes for later production by a commercial company.

Miniature Pitot static tubes used in respiratory research to measure air flow in bronchial passages.

Forceps for gripping biopsy type needles during special radiological procedures.

Custom defibrillator paddles — unavailable commercially.

Custom implant prosthesis which served to reattach the spine to the skull of a patient disabled by severe deterioration of the upper vertebrae.

Upon the invitation of the Department of Trade and Commerce we prepared a display of items developed by our Section which might be of interest to local manufacturers. The display was also designed to demonstrate the ability of the Department of Medical Physics to undertake prototype development of medical instruments. Much interest was expressed and one local manufacturer is now producing one of the items which were on display.

Fabrication of custom plastic moulds continues to be the main activity in the mould room where 531 patients were fitted in 1986. Subsequent refitting required as planning and treatment progressed brought the total of patient visits to 1,055, a slight increase from the previous year. Sealed source deliveries dropped substantially from 212 in 1985 to 139 in 1986, but requests for other services such as lead shields, cerrobend shields and wax boluses all increased. A relatively new service has been introduced involving custom shaped electron field definers to be used with the Sagittaire linear accelerator. The positioning of these treatment aids in close proximity to the patient is accomplished by direct attachment to the "uvex" shells which are routinely fabricated for many head and neck patients treated in our institution.

Mould room expertise in vacuum forming prompted requests from areas outside the normal routine. These included models used in teaching respiratory exercises and home dialysis, and closer to our hearts was a model of a young patient which is now used to help reassure children about to undergo radiation treatment.

The mould room personnel were happy to host and teach interested visitors which included a number of students, nurses and doctors.

## NUCLEAR ELECTRONICS

*W. Stepaniuk*

The Nuclear Electronics Section comprising five technologists, continues to provide fast and efficient equipment service and preventative maintenance to Radiotherapy and Nuclear Medicine centrese in Winnipeg. These centres are the Manitoba Cancer Foundation, Health Sciences Centre, St. Boniface Hospital, Grace, Victoria, Misericordia and Seven Oaks Hospitals.

The workload of this Section continues to increase annually with major equipment purchases and increased requests to supply support services to areas such as Cell Biology, Radiopharmacy and Breast Screening. In 1986 with the Sagittaire Linear Accelerator being run 16 hours per day, we have started to provide standby service after normal working hours, to ensure minimal interruption to patient treatments. Major equipment additions to our service list this year are a new Technicare Gemini 700 Gamma Camera installed at H.S.C. Nuclear Medicine Section and an old Picker Therax Simulator that was rebuilt by Nuclear Electronics and Medical Devices and put into service at the St. Boniface Radiotherapy Unit. To be able to supply competent and efficient service to this new equipment, our technologists attend factory training courses. These included in 1986 a Technicare Gemini 700 Gamma Camera course and a GE Maxicamera course.

Performance of Radiotherapy and Nuclear Medicine Equipment in 1986:

1. The AECL Theratron 780 at St. Boniface General Hospital continues to provide good service with no major interruptions.
2. The rebuilt Picker Therax Simulator put into service early in 1986 at St. Boniface General Hospital provided good service for the remainder of the year.
3. The Theratron 780 $Co^{60}$, the Siemens 250 KV X-Ray and the Siemens Chaoul Therapy units at the Manitoba Cancer Foundation continued to give dependable service with only minor interruptions.
4. The 4 MV Linear Accelerator experienced two major breakdowns during the year, resulting in the unit being out of service for 2 weeks. Both faults were attributed to malfunctioning circumators.
5. The Sagittaire Linear Accelerator experienced one major breakdown, when the Power Klystron Tube had to be replaced due to a shorted filament. With the accelerator running 16 hours per day, the unit has had several scheduled down times in order to rebuild the system's water pump, replace water supply lines, overhaul the collimator and rebuild the Master RF Oscillator.
6. The AECL Therasim 750 and the Picker Therax Simulators at the Manitoba Cancer Foundation experienced no major problems.
7. Nuclear Medicine equipment at Health Sciences Centre had no major breakdowns, with

only minor interruptions during the year. The same can be said for St. Boniface Grace, Misericordia, Victoria and Seven Oaks Hospitals.

## 3. RADIATION PROTECTION

*A. M. Sourkes*

In 1986 the Radiation Protection Section (RPS) continued administration of X-Ray Safety Regulation 207/79 under the Public Health Act and enforcement of Manitoba Regulation 207/77 with request to radiation hazards under Chapter W 210 of the Workplace Safety and Health Act for the Departments of Health and Environment, Workplace Safety and Health, respectively.

Under the X-Ray Safety Regulation, the major effort of the RPS continued to be the surveying of all X-ray units throughout the Province. Included as part of this survey effort was the annual mail out TLD radiation survey performance-evaluation of 545 dental x-ray units. The RPS continued to act as the intermediary for the TLD (thermoluminescent dosimeter) plaque radiation monitoring service in use by the 5000 X-ray workers in the Province. This responsibility includes checking for proper usage of the service by the 550 groups involved, registering and deregistering groups as required, investigating undue exposures and compiling an annual summary of all exposure data.

Under the Workplace Safety and Health Act, in the area of non-ionizing radiation protection a total of 553 device inspections were carried out. Approximately 60% of these inspections were at industrial-commercial locations with the remaining 40% being at medical and paramedical facilities. Examples of potentially hazardous non-ionizing radiation emitting devices surveyed during the inspections are radiofrequency induction-heaters, glue dryers, leather curing dryers, heaters, sealers and diathermy devices; ultraviolet-light platemakers, blue line, silk screening, and camera lamps, ink curing and suntanning lamps; ultrasound therapy devices, paramedical, medical, construction, industrial, research, ophthalmological and display entertainment lasers. In addition to the inspections and survey work, 11 information packages were sent to concerned groups and individuals in response to enquiries about radiation emissions from video display terminals.

Other activities included the provision of consulting services to the Department of Environment and Workplace Safety and Health in the area of environmental radioactivity, response to public inquiries on ionizing and non-ionizing radiation matters, the delivery of radiation-related lectures on request, emergency response to incidents involving the use or transport of radioisotopes, the performance of wipe test analyses for isotope licencees and the design, inspection and approval of new x-ray facility barrier installations. The environmental radiation monitoring program of ground and surface waters in the vicinity of the Underground Research Laboratory (URL) in southeastern Manitoba continued, being a portion of the Provincial Environmental Monitoring Program of this project. Participation in the national technical committee dealing with the management of low level radioactive waste continued in 1986. The U.S. Crystalline Rock High Level Rad Waste Repository Siting Program was reviewed and suitable comments on the potential environmental impact on Manitoba of a Red River Valley Site were submitted as part of the technical review of this program. As well, contributions were made to the Federal/Provincial Environmental Impact Review Process of the proposed US involvement with the URL research project.

With the Chernobyl Reactor Accident in April 1986 numerous public enquiries were responded to, and radiation monitoring was carried out on request for persons returning from European travel.

## SUMMARY OF ALL 1986 RADIATION PROTECTION ACTIVITIES

| Activity | Number |
|---|---|
| Protective Barrier Room Design Approvals | 89 |
| Protective Barrier Installation Inspections | 35 |
| Dosimetry Exposure Investigations | 13 |
| Wipe Sample Analysis | 262 |
| Response to Public Inquiries | 481 |
| Radiation Safety Lectures | 11 |
| Mail-In Dental Unit Checks | 545 |
| Non-Ionizing Device Surveys | 553 |
| X-Ray Machine Inspection | 650 |
| Miscellaneous Surveys | 31 |

## SUMMARY OF 1986 X-RAY MACHINE REGISTRATION AND INSPECTION DATA

| Type of Installation | Total Registered | In Service | Surveyed in 1986 | Approved Initially | Corrected & App. During Survey | Approval Withheld | Approved Subsequently |
|---|---|---|---|---|---|---|---|
| Chiropractic | 38 | 35 | 32 | 25 | 1 | 6 | 5 |
| Dental | 821 | 807 | 257 | 184 | 15 | 58 | 55 |
| Educational | 58 | 54 | 9 | 8 | 0 | 1 | 1 |
| Hospital | 163 | 157 | 119 | 103 | 0 | 16 | 15 |
| Industrial | 29 | 28 | 6 | 6 | 0 | 0 | 0 |
| Lab & X-ray | 129 | 127 | 126 | 100 | 1 | 25 | 22 |
| Medical Off. | 73 | 72 | 65 | 47 | 0 | 16 | 14 |
| Veterinarian | 74 | 74 | 36 | 23 | 3 | 10 | 9 |
| **Totals** | **1,385** | **1,354** | **650** | **496** | **20** | **132** | **121** |

## SUMMARY OF 1986 NON-IONIZING RADIATION INSPECTIONS

| Type of Inspection | Surveyed in 1986 | Approved Initially | Corrected and Approved During Survey | Approval Withheld | Approved Subsequently |
|---|---|---|---|---|---|
| **Industrial and Commercial Facilities** | | | | | |
| Lasers | 6 | 2 | 4 | 0 | 0 |
| Radio-frequency Devices | 16 | 6 | 8 | 2 | 2 |
| Microwave Devices | 20 | 18 | 1 | 1 | 1 |
| Ultraviolet Radiation Devices | 225 | 83 | 96 | 46 | 37 |
| Miscellaneous Devices | 69 | 69 | 0 | 0 | 0 |
| **Medical Facilities** | | | | | |
| Lasers | 6 | 1 | 5 | 0 | 0 |
| Radio-frequency Devices | 29 | 0 | 29 | 0 | 0 |
| Ultrasound Therapy Devices | 162 | 93 | 39 | 30 | 16 |
| Ultraviolet Radiation Devices | 20 | 13 | 7 | 0 | 0 |
| **Totals** | **553** | **285** | **189** | **79** | **56** |

## 4. ACADEMIC ACTIVITIES

The Department continues to play a vital role in the training of Medical Physicists, Residents in both Radiotherapy and Radiology and Radiation Technology Students.

Graduate courses in Medical Physics are offered by members of the Department through the Physics Department of the University of Manitoba. As part of this program 3 credit hour courses in Radiation Physics (9 students) and Radiobiology (5 students) were offered in 1986. Two students (R. T. Constable and A. Tsoukatos) successfully graduated with a Master of Science degree and one new student (Y. McFarlane) joined the program. At the end of 1986 two Ph.D. and 4 M.Sc. students were enrolled. In addition to the Medical Physics program, twelve hours of lectures were offered to University of Manitoba students taking the Accelerator Physics Program.

As a result of the close liaison between the two Physics departments, Medical Physics representatives sit on University Physics Committees and the University is represented on the Graduate Program Committee of the Department of Medical Physics.

In 1986 the Department offered fifteen hours of lectures to Diagnostic Radiology Residents and, as a consequence of the value of this activity, it is likely that this program will be expanded in the near future.

Participation in the training of Radiotherapy Technologists continues to be a major component of the Department's teaching load. In excess of 70 hours of lectures were delivered by members of the Department. In addition laboratory classes were organized and supervised. On average at least one student was in the Department at any time receiving individual tuition on the practice and theory of Radiotherapy Technology.

Besides the Department's commitment to established training programs, staff frequently contribute to Seminar Series organized by the Departments of Radiotherapy and Radiology.

The Department's own Seminar Series comprised, in 1986, 19 talks delivered by both internal and external speakers.

## 5. RESEARCH AND DEVELOPMENT ACTIVITIES

### CLINICAL HYPERTHERMIA

*P. B. Dunscombe, K. Malaker, J. McLellan, R. T. Constable and A. Tsoukatos*

Clinical use of the locally developed hyperthermia facility continued in 1986. Improvements were made in the design of the multisensor thermometers to reduce the significance of self heating artefacts on the accuracy of temperature data acquired. Changes in the controlling software were also implemented in the light of the clinical experience gained with the system. In particular the thermometry system has been modified to facilitate the collection of thermal washout data which are capable of illustrating and the possibly quantifying blood flow changes during treatment. A dynamic phantom has been constructed and tested with a view to undertaking studies of the influence of blood flow on temperature distributions produced by the clinical applicator. The major impediment to the expansion of the clinical program remains the shortage of technical assistance.

### PATIENT ACTIVATION DURING HIGH ENERGY PHOTON RADIOTHERAPY

*P. B. Dunscombe, W. Huda, J. M. Gillies, J. McLellan*

A quantitative study of patient activation at 25 MV has been completed. For the first time data are available on the activity produced per unit volume per unit dose. A gamma camera has been used to image a treatment portal by the distribution of induced activity. The data obtained have permitted a realistic assessment of the feasibility of undertaking PET studies on patients treated with radiotherapy. Such studies would be capable of yielding valuable information about blood flow and its changes during a course of radiotherapy treatment.

### PROTON THERAPY

*P. Dunscombe, V. P. Derenchuk,* J. R. Anderson,* D. Gallop,* J. S. C. McKee,* K. Malaker, G. Froese, J. McLellan*

*Department of Physics, University of Manitoba

Of the heavy particles proposed for use in radiotherapy, protons are amongst the most promising particularly from the dose distribution aspect. Preliminary studies have been carried out on the University of Manitoba 50 MeV cyclotron to assess the feasibility of employing this machine for clinical radiotherapy. The Bragg peak has been identified with the aid of a diode in a water bath. Field flatness under conditions of a defocussed beam and contamination of the beam have also been investigated. Experiments completed to date have indicated that targets within 2 cm. of the surface could be effectively treated with some minor modifications to the existing facility. Thus approximately 70% of choroidal melanomas, for which this modality has proven value, would be amenable to treatment with the 50 MeV beam available.

## EXPERIMENTAL HYPERTHERMIA OF THE SPINAL CORD

*G. Froese, P. Dunscombe*

The spinal cord is often a dose-limiting tissue in radiotherapy. We intend to investigate in mice the thermal enhancement of radiation damage to the spinal cord and to determine the obtainable therapeutic gain by combining x-irradiation and hyperthermia (42° 43°C). Controlled heating of the thermal cord presents technical difficulties. We have developed an experimental technique of heating by a combination of circulating hot water and radiofrequency heating, and have established the relationship between the temperature of the spinal cord and that at points outside the cord. Changes in blood perfusion with heating have been estimated from thermal washout curves.

## QUANTIFICATION OF RADIOTHERAPY TREATMENT PLANS

*S. Shalev, P. Hahn, P. Therrien, L. Bartel, M. Carey*

The selection of one from many alternative treatment plans usually involves the progressive elimination of plans with the highest degree of undesirability, using isodose plots in one or several planes. This tedious and subjective procedure has been greatly improved by the modification of our THERAPLAN system to give images of regret, in which areas exceeding predefined limits of acceptability are shown in appropriate colours. Score functions are also calculated, and provide quantitative figures of merit for the comparison of competing plans. The biological effect of each plan is predicted from tissue-specific dose response curves, using dose-volume histograms and partial volume correction factors. These objective evaluation procedures have been applied to the optimization of treatment planning for cancer of the prostate, stages A2 and B.

## PORTAL IMAGING

*S. Shalev, K. Malaker, S. Cosby*

The quality of portal films is of vital importance for the verification of precise treatment beam location. A commercial phantom has been modified to permit objective observer studies of portal films under different clinical conditions, and a computer program was developed to analyse the data in terms of scores, sensitivities and ROC plots. Portal film quality has been studied for several film/cassette combinations, for bare film and film packs, for cobalt and high energy radiation, and for different air gaps. The effect of observer performance and reading conditions were also studied.

## BIOMEDICAL NUCLEAR MAGNETIC RESONANCE

*W. Huda, J. Peeling, G. Froese*

A multidisciplinary group of physicists, chemists, radiologists and basic scientists has been formed to develop a research programme in biomedical NMR. A research scientist (Dr. Jim Peeling) was taken on in May 1976 for a one year period to 1) evaluate the suitability of existing NMR equipment at the University of Manitoba and the University of Winnipeg for biomedical work, 2) to initiate research programs in biomedical NMR, 3) to determine the extent of interest among researchers in using NMR in biomedical research programs.

The biomedical NMR research programs that are currently underway using existing facilities include:

1. Dependence of proton NMR relaxation times in tissues on the magnetic field strength
2. Analysis of CSF from rats following induced forebrain ischemia
3. Safety aspects of *in vivo* NMR
4. NMR studies of normal and cancerous cells.

Plans are currently in progress to develop and implement a comprehensive 5 year plan for biomedical NMR in the Province of Manitoba based on the present activities of the multidisciplinary group.

## MEASUREMENT OF REGIONAL CEREBRAL BLOOD FLOW

*T. Lee, P. B. Dunscombe, M. Kroeker*, B. McClarty*, M. West+, R. Ellis, R. Palser*
*Department of Physics, University of Manitoba
+Surgery, St. Boniface General Hospital

This project aims at developing methods for measuring regional cerebral blood flow in clinical situations using existing diagnostic imaging modalities. One method currently under investigation is stable xenon enhanced computed tomography (CT). A series of phantom experiments was carried out with the General Electric 9800 CT scanner. The results indicate that the method is feasible provided the CT scanner is calibrated properly. A set of software programs are being developed to enable the derivation of regional cerebral blood flow (rCBF) and xenon partition coefficient (rXePC) from the CT scans of patients. When completed, patient studies will commence. We plan to study a group of glioblastoma multiformae patients to investigate: (1) the potential of regional cerebral blood flow in the tumour as a prognostic indicator of patient survival; (2) whether radionecrosis of normal brain tissue, manifested as changes in rCBF and rXePC, occurs as a result of radiation treatment of the patient. Concurrent with the software development, we are using computer simulation techniques to study the precision and accuracy of the derived rCBF and rXePC values from the CT scans obtained under clinical conditions.

We are also studying the feasibility of another method of measuring rCBF using single photon emission computed tomography (SPECT) and a freely diffusible agent Tc-99m HMPAO which crosses the blood brain barrier and then is trapped in the brain. The advantage of this method is that three dimensional rCBF measurement is possible because it is not confined to a single slice as in the case of xenon enhanced CT. However, the localization (spatial resolution) of SPECT is inferior to CT.

## WHOLE BODY DOSIMETRY

*R. Palser, M. Billinghurst*, J. B. Sutherland**
*Department of Radiology, Health Sciences Centre

The object of this study is to measure the radiation dose distribution to various body organs resulting from the injection of Technetium labelled bone seeking radiopharmaceuticals. Two gamma cameras were obtained, mechanically modified and electronically interfaced to a data acquisition computer. The system has been calibrated and collection of patient data begun. To date about 30 volunteer patients have undergone repeated whole body surveys.

The activity in various organs, soft tissues and bones has been determined as a function of time and used to calculate the radiation dose distribution to the various body organs.

## ELECTRON DOSIMETRY

*W. Huda and G. A. Sandison*

Work has continued on the application of the Fermi electron transport equation to characterize a magnetically scanned broad electron beam from the Sagittaire Therac 40 accelerator in the air space above patients. A relationship has been derived between broad beam penumbras and the value of the root mean square spatial Gaussian spread of an elementary pencil beam which is applicable to any rectangular field size. The model developed has an isotropic point source located at the exit window of the accelerator. This model enables accurate predictions of beam profile for any clinically used beam energy, SSD or field size in the presence of lead trimmer collimation without the use of "empirical" input data. The application of this model has been extended to more complex cases where a penumbra is formed by a dual collimation system such as the Sgittaire photon collimation arrangement. The work has been written up and submitted for publication. An extension of the Fermi electron scattering theory into different absorbing media of clinical interest is currently underway.

A Prairie Electron Group (PEG) was formed in October 1986 with another electron dosimetry group (J. Scrimger and J. J. Battista) based at the Cross Cancer Institute in Edmonton. The PEG plans to collaborate on an electron dosimetry project utilizing the complimentary expertise and equipment available at the two centres. It is envisioned that a major joint research proposal will be prepared for submission to a national funding agency.

## QUALITY CONTROL

*W. Huda and T. Lee*

The main areas of work have been in the development of QC protocols in Computed Tomography and Nuclear Medicine. In addition, a film processor QC programme has been implemented in the Nuclear Medicine departments of both teaching hospitals in Winnipeg. Current work is aimed at developing a Quality Control Programme for digital x-ray units, and SPECT (Single Photon Emission Computed Tomography) units in nuclear medicine.

## RADIATION PROTECTION AND DOSIMETRY

*W. Huda, K. Gordon*

The activities of the group have been aimed at the development of procedures for use in the safe handling of unsealed radionuclide sources. To this end, derived limits have been obtained for contamination monitoring instruments and a policy developed based on the estimated risks to medical radiation technologists during pregnancy.

A major effort has been made to employ the effective dose equivalent, $H_E$, in all the areas of radiology that employ ionizing radiations. Close attention has also been paid to the staff and patient radiation doses in nuclear medicine and this work is currently being prepared for publication.

Following the Chernobyl nuclear accident, assessments of the medical consequences for various population categories were performed. A detailed evaluation of the radiological impact of the Chernobyl fallout on Canada was also undertaken using data on environmental contamination collected by the Bureau of Radiation and Medical Devices.

## THE RADIATION TREATMENT OF MESOTHELIOMA

*M. Soubra and P. Dunscombe*

The aim of radiation treatment for patients with malignant pleural mesothelioma is to deliver the required dose to the pleural membrane and a predetermined margin, while keeping the lung dose to a minimum. Optimum treatment techniques involve a combination of electron and photon fields with lung shielding during the photon beam irradiation. Various significant problems may arise during the implementation of this technique. Non-uniform dose distribution in the join up region of the two fields, increased electron penetration into the lung, increased lung dose from photon side scatter and the existence of tissue inhomogeneities in the electron and photon fields are among the major problems encountered. To investigate the significance of these effects a special phantom simulating the soft and lung tissue has been constructed and dose distributions, under various simulated clinical conditions, are being assessed.

## ELECTRON DOSIMETRY OF IRREGULAR FIELDS

*M. Soubra, G. Froese*

The use of non-rectangular fields to treat irregularly shaped targets can lead to significant dosimetry complications. The dose for a given irregular field generally has been measured individually for each patient. However, this approach becomes impracticable as the clinical load rises. A method based on Clarkson's integration technique and measured data has been developed to predict the absorbed dose from an irregularly shaped electron field. Results have shown an agreement in the range of 1 to 5% between measured and calculated data. The advantage of this method of dose prediction is in the requirement of only a small set of measured data. This method is being implemented on our treatment planning computer for routine clinical dosimetry.

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Constable, R. T., Tsoukatos, A. and Dunscombe, P. B. "The significance of heat production in microwave irradiated thermocouples. WESCAN Conference, Saskatoon, March 1986.

Constable, R. T., Dunscombe, P. B. and Tsoukatos, A. "Perturbation of the temperature distribution in microwave irradiated tissue due to the presence of metallic thermometers. Annual Meeting of the North American Hyperthermia Group, Las Vegas, April 1986.

Constable, R. T., McLellan, J., Tsoukatos, A., Malaker, K. and Dunscombe, P. B. "Heat production in microwave irradiated thermocouples". Annual Meeting of the Canadian Association of Radiologists, Halifax, June 1986.

Dunscombe, P. B., McLellan, J. and Malaker, K. "Heat production in microwave irradiated thermocouples". Annual Meeting of the North American Hyperthermia Group, Las Vegas, April 1986.

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# ONCOLOGY SOCIAL WORK

**DIRECTOR — B. S. H. Wong., M.S.W., R.S.W.**

**SOCIAL WORK STAFF**

Beatrix Pociwauschek, B.S.W., R.S.W.

**SUPPORT STAFF**

Anneliese Friedle

**SOCIAL WORK STUDENT**

Mark Sagan

## Annual Report — 1986

### Organization

Oncology Social Work was established jointly in 1974 by the Health Sciences Centre and the Manitoba Cancer Treatment and Research Foundation. As a joint program, the first social worker was employed by the Health Sciences Centre and seconded to the Manitoba Cancer Treatment and Research Foundation as its Director of Oncology Social Work. This arrangement continues to the present time. As a staff member of the Health Sciences Centre and the Manitoba Cancer Treatment and Research Foundation, the director is accountable to both institutions. The second social worker and the departmental secretary are staff of the Foundation.

Social work consults continue to increase proportionately to the overall increase in cancer patient population. Oncology Social Work has managed to meet the heavy demand for services by carefully examining its priorities. Professional time is used only if it is appropriate and necessary. We have learned to priorize our caseload and to make the best use of the support staff. Consequently the department is able to fulfil it's commitment: to strive for excellence in providing quality care to the cancer population and consultation services to those community agencies who seek our assistance.

### Patient Care

1. Counselling services are provided to cancer patients and their families who have difficulties coping with their disease at different stages of development. Some require brief but intensive counselling at the initial stage of diagnosis to cope with the shock; others require counselling to help sustain their family's equilibrium during the period of remission; still others require counselling in anticipation of their impending death and subsequent bereavement and for their families. Ideally, patients in the above mentioned categories should seek early social work consultation in order to avoid more serious problems which may need psychiatric interventions at a later date.

2. Referral Services: Because long term treatment procedures frequently interrupt productive employment, many patients do not have sufficient resources to support themselves and their families. Resource counselling is provided to those who are experiencing financial

difficulties during their illness. After proper assessment and intervention, referrals are made to the appropriate financial agencies in the community.

Referrals are frequently made to the Home Care Department for services to enable patients to continue to function in the community, minimizing hospitalization. Requests for certain practical services are made to the Cancer Society through their office at the Foundation.

On occasion, psychiatric consultation is sought regarding cases that are followed for ongoing counselling by the Oncology Social Work staff.

3. Discharge and Transfer to Other Institutions: Discharge planning for inpatients continues to demand a great deal of our time. Many patients and their families find it difficult to accept the fact that they can no longer function in the community and therefore may need care. Actual transfers to the Princess Elizabeth Hospital and other health care institutions are handled by the Social Work Assistant at the Health Sciences Centre, Department of Social Work.

4. Coordination: Many inpatients at the Health Sciences Centre are under the care of a multidisciplinary team. They and their families often find this confusing and frustrating as they have to deal with such a large bureaucratic system. To facilitate communication among all disciplines involved, the social worker often acts as a case coordinator setting up case conferences with those who are involved in the patient's care.

## Education

1. *Social Work*: Oncology Social Work continues to be a student field placement for the University of Manitoba, School of Social Work. During this academic year, an undergraduate student receives his clinical experience at the Cancer Foundation.

> *Publication:* Based on her graduate work with our department in 1981, Kathleen Joan Henson presented us with "Cancer As a Chronic Illness: A Strength-Oriented Approach to Social Work Practice — Reshaping an Ecological Perspective". This 361 page book is a practicum report submitted in partial fulfillment of the requirements for the degree of Master of Social Work in the School of Social Work, University of Manitoba, September, 1985.

2. *Nursing*: After one year of recess, B.N. students from the Faculty of Nursing, University of Manitoba, resumed their association with Oncology Social Work. Thirty patients and/or families were selected for them to follow in the community. According to reports from students, patients and staff, this program was perceived as a worthwhile endeavour and should be continued as an ongoing contribution to nursing education.

3. *Other Disciplines*: Oncology Social Work continues to be involved with the education of students from other disciplines. These educational activities include inservices and informal classes as well as having students spend time in our department.

## Other Activities and Developments

1. Oncology Social Work-Nursing Rounds: Since its establishment in 1982, these rounds continue to meet on a weekly basis and have served its three-fold purpose:

a. To provide better patient care through early problem identification.

b. To facilitate an educational forum for students.
c. To foster interdisciplinary understanding and mutual support.

2. Mastectomy Patients: Due to our heavy case load, our former routine assessment of all mastectomy patients had to be discontinued. However, we continue to maintain close liaison with the surgical wards who request mastectomy volunteers as they need them. This important function has been well performed by the department secretary.

3. Brain Tumour Clinic: The brain tumour clinic was established near the end of the year. Oncology Social Work has been an integral part of this multidisciplinary team from the beginning. So far, referrals from this clinic have been averaging about 3-4 cases per week.

4. Membership of CAPO: Oncology Social Work is a member of the Canadian Psychosocial Oncology Association which was founded in the year under review. "The Association's purpose is to foster excellence in interdisciplinary research, education and clinical practice in the psychosocial care of patients with cancer and their families".

5. M.S.W. Admission Committee — U. of M. School of Social Work. For the past two years the director has been appointed by the Manitoba Association of Social Workers as its representative to sit on the above mentioned graduate program's admission committee. This is a working committee with frequent weekly meetings in March and April.

6. Patient Information Pamphlet — Initiated the year before, this project was finally completed during the year under review. My personal appreciation and sincere thank-you are extended to the committee members, Sharon Switzer, Julie Lamb, and all staff on the coordinating committee. Credit should be given to July Searle the original chairman and all the volunteers.

7. Workload Measurement System — As requested by the federal and provincial governments, Oncology Social Work joins the Health Sciences Centre Departments of Social Work and other Social Work Departments in health settings across the country to use a system whereby workload data and patient counts are recorded. This system is designed to reflect our professional service delivery to patients.

### Public Relations

Oncology Social Work continues to perform its unofficial duties in the field of public relations as we have often been called upon to provide information and consultation to our colleagues in the community. Many non-patient related inquiries are referred to this department for exploration and appropriate responses.

# BREAST CANCER SCREENING UNIT

| | |
|---|---|
| **Medical Director:** | D. M. Bowman, M.D., B.Sc.(Med.), F.R.C.P.(C) |
| **Co-ordinator:** | Patricia Edward, B.S.N. |
| **Surgeons:** | W. A. Beecroft, M.D., F.R.C.S.(C)<br>T. K. Thorlakson, M.D., F.R.C.S.(C) |
| **Radiologists:** | G. Hardy, M.D.<br>H. Standing, M.D. |
| **Pathologists:** | H. Yazdi, M.D.<br>J. Safneck, M.D. |
| **Nurse Examiners:** | M. Blanchard, R.N.<br>A. Crossin, R.N.<br>J. Kosteniuk, R.N.<br>V. Powell, R.N. |
| **Radiographers:** | N. Einarson<br>V. Kowalski<br>B. Moore |
| **Secretaries** | R. Brown<br>M. DiBiase<br>D. Nickel |

The Manitoba Unit of the National Breast Cancer Screening Study, opened in 1981, continues to rescreen committed volunteer women for breast cancer, averaging 550 visits monthly and had a 82% return rate for 1986.

The Study is designed to:

Determine the extent to which mammography (MA) is responsible for reducing death rates in well women aged 50-59 years.

Determine whether deaths from breast cancer is reduced in well women aged 40-49 years, who are screened by mammography and physical examinations annually for five years compared to volunteers allocated to a control group.

Analyze the contribution of various risk factors to the development of breast cancer.

Analyze the cost effectiveness of breast screening.

Provide detailed information regarding the natural history of breast cancer as detected in such a regular screening programme.

All visits by volunteer participants during this year were the final rescreen visits fo the majority. These women were issued their earned citation "Lease on Life".

Women between the ages of 40-49 years, not allocated to mammography, continu to respond to their annual questionnaires which detail their practice of Breast Self Examination, and any interval interventions.

## TABLE I
## Volunteer Recruits in Screening Study

| | 1985 | 1986 | Cumulative Accrual 1981-1986 |
|---|---|---|---|
| Volunteers Registered | — | — | 10,114 |
| Randomized to 'Control' | — | — | 5,054 |
| Randomized to 'MA' | — | — | 5,060 |
| Cancers Detected | 21 | 21 | 127 |
| Cancers By Age Group: | | | |
| 40-44 | 03 | 05 | 19 |
| 45-49 | 05 | 07 | 34 |
| 50-54 | 08 | 05 | 41 |
| 55-59 | 05 | 04 | 33 |

Interest in this National Study continued, as manifested by the number of requests for information and on site visits.

Guests from the Rotterdam Comprehensive Cancer Centre, Aron Gaiser and Mrs. Hanna deBoer-Sitters, spent one day with the staff.

Students from the Health Sciences Centre, School of Nursing, Radiotherapy student technicians and nursing students from the University of Manitoba also use the Unit as a learning resource.

Various groups of women in the community, including the Occupational Health Class at the Red River Community College, continue to invite the Unit Coordinator to share information about the Study and the practice of BSE as well.

The shared referrals with the Diaphanography Research Programme continued during 1986.

It is anticipated that the Study mandate for the Manitoba Unit will have been met by the spring of 1987.

# MANITOBA INSTITUTE OF CELL BIOLOGY

**Director** — G. J. Goldenberg, M.D., Ph.D., F.R.C.P.(C), F.A.C.P.

A. Begleiter, Ph.D.
L. J. Brandes, B.Sc., M.D., F.R.C.P.(C)
D. Chow, Ph.D.
J. G. Dodd, Ph.D.
J. M. Gerrard, M.D., Ph.D.
A. H. Greenberg, M.D., Ph.D.
E. D. Israels, B.A., M.Sc., M.D.
S. J. Israels, M.D., F.R.C.P.(C)
J. Johnston, M.D., F.R.C.P.(C)
N. Kobrinsky, M.Sc.(Med.), M.D., F.R.C.P.(C)
H-Y. P. Lam, Ph.D.
S-T. Lee, Ph.D.
M. Mowat, Ph.D.
F. Paraskevas, M.D.
B. A. Schacter, B.Sc.(Med.), M.D., F.R.C.P.(C)
J. A. Wright, B.Sc., M.Sc., Ph.D.

## GRADUATE STUDENTS

C. Anhalt, E. Atkinson, R. Bennet, B. Choy, J. Damen, S. Egan, M. Jesson, J. Hickerson, J. Hicks, R. Kraut, T. Osachuk, M. Reese, E. Roussell, P. Sandstrom, C. Seneviratne, A. Tagger, D. Tough, S. Uniyal.

## POSTDOCTORAL FELLOWS

S. Beenken, U. Bhat, A. Deffie, M-C. Gingras, N. Khalil, G. McClarty, D. Rittman.

## B.Sc.(MED) SUMMER STUDENTS

J. Boux, K. Harrop, E. Hildes, B. Lavallee, J. Ormiston, S. Taback, K. van Ineveld, D. Winters, A. Wong.

## TECHNICIANS

T. Alam, L. Beattie, O. Bereznay, G. Blair, P. Bogdanovic, A. C. Chan, A. Chan, M. Cawker, M. Chapiel, V. Cripps, N. Cummings, K. Devine, J. Dickson, E. Duta, E. Friesen, L. Heinemann, J. Hellsten, L. Jarolim, D. Johnson, I. Kostolansky, M. Leith, S. Leveque, A. Low, M. MacDonald, J. Maeba, E. McMillan, L. Miller, B. Ottenbreit, S. Ozomoto, L. Pugh, P. Robinson, M. Sauder, L. Schwarz, R. Singal, S. Singhroy, M. Talgoy, C. Ulicki, M. Wilcock, P. Wingert.

## LAB ASSISTANTS

I. Freiter, A. Limpach, M. Monch, I. Tober.

## ANIMAL ATTENDANT

E. Ahola

## SECRETARIES

L. Devlin, N. Eyolfson, D. Faulkner, S. Ireland, M. Kosheluk, S. Richter, S. Snusher, A. Warkentin.

# THE MANITOBA INSTITUTE OF CELL BIOLOGY

The Manitoba Institute of Cell Biology was founded jointly by the University of Manitoba and the Manitoba Cancer Treatment and Research Foundation in 1969. The purpose of the Institute is to carry out interdisciplinary research and training in the basic and clinical aspects of cancer and other diseases by studying disease mechanisms at a cellular level. The Institute of Cell Biology is governed by an independent Board of Management consisting of eleven members, three appointed by the University of Manitoba, three appointed by the Manitoba Cancer Treatment and Research Foundation and five jointly appointed by both sponsoring Institutions. The Manitoba Institute of Cell Biology is housed in the Manitoba Cancer Treatment and Research Foundation adjacent to the Faculty of Medicine, University of Manitoba and the Health Sciences Centre.

The Institute of Cell Biology consists of a Director, seventeen senior investigators, and eighty-six staff including Postdoctoral Fellows, graduate students, summer students, technicians, laboratory assistants, animal attendants and secretaries. Although the Institute of Cell Biology is not a degree-granting body, advanced degrees at the Masters or Ph.D. levels may be obtained by special arrangement with any of the departments in the Faculty of Medicine, University of Manitoba. The major emphasis of the research program of the Institute of Cell Biology has centered on the fields of Oncology, Hematology, Molecular Biology and Immunology. Senior investigators in addition to holding appointments in the Manitoba Institute of Cell Biology also hold cross-appointments in a wide range of University departments including the Departments of Immunology, Genetics, Biochemistry, Physiology, Medicine, Surgery, Pediatrics, Obstetrics and Gynecology, and Microbiology. Other members also have acted as Adjunct Professors in these and other basic science departments, particularly while supervising the thesis work of a graduate student pursuing an advanced degree at either the Masters or Ph.D. level.

The location of the Manitoba Institute of Cell Biology in the Manitoba Cancer Treatment and Research Foundation building has enabled the development of a parallel program of basic and clinical investigation of patients with neoplastic disease. Of particular interest has been the development of tumor immunology, molecular biology and experimental chemotherapy in which patients with a wide range of neoplastic disorders are available for investigation conducted by senior investigators in the Institute. Not only is this interaction facilitated by a geographical juxtaposition of the two Institutions, but also by the fact that many senior investigators hold cross-appointments in the Manitoba Institute of Cell Biology and the Manitoba Cancer Treatment and Research Foundation.

A wide range of research programs were ongoing in 1986. Featured prominently in the research activities of the Institute were programs in biochemical pharmacology, immunology, molecular biology and hematology. Studies on drug resistance provided evidence that resistance to adriamycin, as with alkylating agents, is multifactorial including reduced drug uptake and decreased formation of DNA single and double strand breaks. Drug uptake studies suggested that adriamycin-induced cardiotoxicity in part may be due to higher levels of drug accumulation in heart cells relative to that observed in liver or leukemic cells. A series of adriamycin analogues have been studied in search of agents with a higher therapeutic index than that of adriamycin. Resistance to benzoquinone-mustard conjugates appeared to be due to elevated levels of sulfhydryl groups and of protective enzymes such as catalase and superoxide dismutase. Studies on the mechanism of action of 2'-deoxycoformycin in chronic lymphocytic leukemia showed there was no correlation between antitumor activity and either adenosine deaminase activity, DNA strand breakage or changes in the level of dATP or NAD in leukemic cells. A novel compound DPPE, with binding affinity for the antiestrogen binding site (AEBS), was used to demonstrate that the antiestrogen activity of tamoxifen is mediated through the AEBS whereas estrogenic effects appear to be mediated through the estrogen receptor. Studies on hydroxyurea revealed that the mechanism of drug entry is by passive diffusion. Resistance to hydroxyurea is characterized by a drug-dependent increase in ribonucleotide reductase and modification of the M2 enzyme subunit rendering it more sensitive to the drug bleomycin.

In the area of tumor immunology studies continued on the role of natural resistance, including natural killer (NK) cell activity and natural antibody in tumor progression. Considerable progress was made in understanding NK cell activity. Studies with concanavalin A-resistant Chinese hamster ovary cells showed that complex N-linked oligosaccharides are important for recognition, binding and lysis by NK cells and macrophages. Activation of the inositol cycle was involved in activation of NK cells on exposure to tumors and may be involved in the secretion of lytic proteins from NK cells to cause tumor lysis. A leukocyte chemotactic factor present in NK cell granules appears to be released after tumor-induced granule exocytosis. The effect of modulation of antisuppressor activity was evaluated not only in tumor suppression but also in the graft-versus-host reaction. The interaction of macrophages and T cells and the effect of low dose cyclophosphamide on antisuppressor activity was also investigated.

Further growth and development of the program in molecular biology was particularly gratifying. Transcription of activated H-ras sequences in 10T1/2 tansfectants was associated with tumorigenic transformation as well as expression of the metastatic phenotype. The expression of activated ras may be necessary but not sufficient for development of the metastatic phenotype. A novel mechanism of oncogene regulation was discovered consisting of deletion of the 5'-coding sequences of the cellular p53 gene in mouse erythroleukemia. This mutation arose during neoplastic progression and identifies a region of the p53 protein molecule that plays a role in determining p53 stability in vivo. The truncated protein, which has a molecular weight of 44,000 daltons and is missing the N-terminal end, is unusually stable and accumulates to high intracellular levels. Gene expression in the rat prostate has been studied using cloned cDNA probes to two abundant mRNAs. One cDNA clone (pM-40) corresponds to a mRNA of about 800 nucleotides, encodes for two proteins of 23 and 21 kilodaltons and is inducible by androgen or zinc. A second clone (pRWB) corresponds to a 1.5K base mRNA which codes for a 52 kilodalton protein and is responsive to androgen.

A new recruit, Dr. Sara Israels, joined the hematology program in 1986. Dr. Israels is studying the interaction of a blood protein fibrin with membrane glycoproteins embedded in the platelet plasma membrane and the contractile skeleton of the platelet. These studies will help elucidate how clots form and contract to stop bleeding when a blood vessel is damaged. Studies continue on a family with an inherited platelet-storage pool deficiency and a high incidence of myeloblasstic and myelomonoblastic leukemia. A major effort has been maintained in the investigation of the role of prostaglandins, inositol phosphate metabolism and protein phosphorylation with respect to platelet function. An enzyme-linked immunosorbent assay has been developed to measure 6-keto prostaglandin $F_1$, a stable metabolite of prostacyclin.

To provide additional background information on the nature and type of research programs being conducted in the Manitoba Institute of Cell Biology a series of research abstracts and publications is presented for each of the senior investigators.

## A. BIOCHEMICAL PHARMACOLOGY

### INDUCTION OF DNA STRAND BREAKS IN CHRONIC LYMPHOCYTIC LEUKEMIA FOLLOWING TREATMENT WITH 2'-DEOXYCOFORMYCIN *IN VIVO* AND *IN VITRO*

*Asher Begleiter, Robert I. Glazer, Lyonel G. Israels, Linda Pugh and James B. Johnston*

Four patients with refractory chronic lymphocytic leukemia were treated with the adenosine deaminase inhibitor, 2'-deoxycoformycin, and initially received 4 mg/$M^2$ i.v. weekly. Clinical responses to therapy varied; patient A had a minimal response, whereas patient D showed an 85% decrease in lymphocyte count at 2 weeks, and patients B and C had intermediate responses. The pretreatment mononuclear cell adenosine deaminase activities, which ranged from 1.6-44.6 nmol adenosine/h/$10^6$ cells, decreased to approximately 1 nmol adenosine/h/$10^6$ cells 24 h following 2'-deoxycoformycin, and increased to 15-50% of the pretreatment activity prior to the second drug treatment. The clinical response to 2'-deoxycoformycin was unrelated to the pre- and post-treatment adenosine deaminase activities or to the rate of return of enzyme activities following treatment. The plasma deoxyadenosine levels and the leukemic cell dATP concentrations rose slightly with therapy, but there was no correlation between the magnitude of increase and clinical response. No significant levels of DNA strand breaks were observed in the leukemic cells following treatment, although the NAD levels decreased slightly in 2 patients. When peripheral mononuclear cells from the patients and 2 controls were incubated *in vitro* for 24 h with 2'-deoxycoformycin and increasing concentrations of deoxyadenosine, a concentration-dependent increase in dATP and decrease in NAD was observed in both the patients and normals. The normal cells, and cells from 2 patients, developed a significant number of DNA strand breaks. However, there was no relationship between the formation of DNA breaks and the degree of accumulation of dATP or depletion of NAD, or between any of these changes and subsequent clinical responses to 2'-deoxycoformycin. Based on this study, it appears that the antitumor activity of 2'-deoxycoformycin in chronic lymphocytic leukemia is unrelated to the induction of DNA strand breaks, or to changes in the levels of dATP or NAD in the leukemic cells.

### MECHANISMS OF RESISTANCE TO QUINONE ANTITUMOR AGENTS

*A. Begleiter and M. Leith*

L5178Y and L5178Y/HBM10 cells are mutant cell lines developed for resistance to the model quinone antitumor agent, hydrolyzed benzoquinnone mustard (HBM), and are

2.5-fold resistant to HBM, respectively. Both cell lines have elevated levels of catalase, with L5178Y/HBM2 cells showing a 25% increase in catalase, while L5178Y/HBM10 cells contain twice as much catalase as parental sensitive cells. Both cell lines also show slightly elevated levels of superoxide dismutase and sulfhydryl groups. The increased concentrations of catalase and superoxide dismutase appear to be due to elevated levels of m-RNA for these two enzymes but to gene amplification. HBM produces fewer DNA strand breaks in the resistant cell lines compared to L5178Y sensitive cells, while the model alkylating agent, aniline mustard (AM), produces equal numbers of DNA crosslinks in the three cell lines. L5178Y/HBM2 and L5178Y/HBM10 cells are 7.5- and 8.5-fold resistant to the quinone alkylating agent benzoquinone mustard (BM). DNA double strand breaks and DNA crosslinking produced by BM is reduced in the resistant cell lines. Since the alkylating activity of BM is greatly enhanced by reduction of the quinone group, the reduced crosslinking by this agent, as well as the other levels of DNA strand breaks produced by the quinone antitumor agents, may be due to a diminished ability of the resistant cells to reduce the quinone functional group. Therefore, resistance to quinone antitumor agents may be due to the failure of cells to reduce the quinone group and to elevated levels of cell protective enzymes and sulfhydryl groups.

## NEW EVIDENCE THAT THE ANTIESTROGEN BINDING SITE MAY BE A NOVEL GROWTH-PROMOTING HISTAMINE RECEPTOR (?$H_3$) WHICH MEDIATES THE ANTIESTROGENIC AND ANTIPROLIFERATIVE EFFECTS OF TAMOXIFEN

*Lorne J. Brades and R. Patricia Bogdanovic*

Using as a probe [$^3$H]-DPPE (N,N-diethyl-2-[(phenylmethyl)phenoxy]-ethamine HC1, a novel compound selective for the antiestrogen binding site (AEBS), new evidence is presented that this site could be a growth-promoting histamine receptor of a type not previously described (?$H_3$). In the rat uterus, DPPE alone at a concentration of 1 mg/kg acts as an estrogen antagonist, unlike TAM alone which is a partial estrogen agonist. In the presence of exogenous estradiol, both TAM and DPPE are partial antagonists. This suggests that the "atiestrogenic" effects of tamoxifen are mediated through AEBS/?$H_3$ while the estrogenic effects are mediated through ER.

## THE ANTIPROLIFERATIVE PROPERTIES OF TAMOXIFEN AND PHENOTHIAZINES MAY BE MEDIATED BY A UNIQUE HISTAMINE RECEPTOR (?$H_3$) DISTINCT FROM THE CALMODULIN-BINDING SITE

*Lorne J. Brandes, R. Patricia Bogdanovic, Max D. Cawker and Ratna Bose*

N,N-diethyl-2-[4-phenylmethyl)-phenoxy]-ethanamine HC1 (DPPE) a novel histamine antagonist (?$H_3$), which selectively binds with high affinity to the antiestrogen-binding site (AEBS/?$H_3$), inhibits the activity of calmodulin-dependent myosin light chain kinase (MLCK) only at concentrations >1mM, as opposed to tamoxifen (TAM), which has an $IC_{50}$=4 $\mu$M in the same assay. This suggests that the antiestrogen-binding site is distinct from the site on calmodulin which binds TAM and phenothiazines. However, at an in vitro concentration of 1 x $10^{-6}$M, the antiproliferative effects of DPPE and several phenothiazines, which also compete for binding to AEBS/?$H_3$, are about equal; this suggests that affinity for AEBS/?$H_3$ rather than that for the calmodulin-binding site may correlate with clinically relevant antigrowth effects of these compounds.

## RESISTANCE TO ADRIAMYCIN: RELATIONSHIP OF CYTOTOXICITY TO DRUG UPTAKE AND DNA SINGLE- AND DOUBLE-STRAND BREAKAGE IN CLONED CELL LINES OF ADRIAMYCIN-SENSITIVE AND -RESISTANT P388 LEUKEMIA

*Gerald J. Goldenberg, Hungshu Wang and Gordon W. Blair*

Cloned lines of adriamycin (ADR)-sensitive and -resistant P388 leukemia have been established from single cell cultures. A marker chromosome M1 was found in all cells in the heterogeneous resistant P388/ADR parental line as well as in the cloned resistant lines P388/ADR/3 and P388/ADR/7; a different marker chromosome M2 was present in the heterogeneous sensitive P388 parental line as well as the cloned sensitive line P388/4. Dose-survival studies showed that $D_0$, the dose of adriamycin reducing survival to 1/e (i.e. 37% of the initial population), was 33 ± 5 (SE) nM for sensitive P388/4 cells, 169 ± 17 nM for resistant P388/ADR/3 cells, and 336 ± 28 nM for the more resistant P388/ADR/7 cells. Drug uptake in sensitive P388/4 cells was 1.6-fold greater than in resistant P388/ADR/3 cells and 2.1-fold greater than in resistant P388/ADR/7 cells. The number of DNA single-strand breaks produced per $\mu$M adriamycin was 131 ± 9 rad equivalents in sensitive clone 4 cells, 41 ± 8 rad equivalents in resistant clone 3 cells, and 33 ± 11 rad equivalents in resistant clone 7 cells. The number of DNA double-strand breaks per $\mu$M adriamycin was 1721 ± 126 rad equivalents in sensitive cells, 117 ± 36 rad equivalents in resistant P388/ADR/3 cells, and 194 ± 16 rad equivalents in resistant P388/ADR/7 cells. Differences in drug uptake were insufficient to explain the higher incidence of DNA single- and double-strand breaks in sensitive cells. These findings strongly support the concept that resistance to adriamycin in P388 leukemia cells is multifactorial; however, this study did not resolve whether these changes arise from a single pleiotropic muttion or from multiple mutations.

In sensitive P388/4 cells the number of DNA single-strand breaks formed could all be attributed to double-strand breaks. However, in both resistant cell lines the level of induction of single-strand breaks was in excess of that due to double-strand breaks, and this excess of single-strand breaks appeared to vary directly with the degree of resistance, being greater in the more resistant clone 7 cells than in the less resistant clone 3 cells. In both sensitive and resistant cell lines the ratio of true single- to double-strand breaks varied inversely with the concentration of adriamycin. Finally, the cytotoxic activity of adriamycin appeared to correlate more closely with formation of DNA double-strand breaks than with single-strand lesions.

## RESPONSE AND RESISTANCE TO ALKYLATING AGENTS IN CHRONIC LYMPHOCYTIC LEUKEMIA

*L. G. Israels, J. B. Johnston, A. Begleiter, G. J. Goldenberg and M. R. A. Mowat*

The alkylating agents, chlorambucil and cyclophosphamide, have been in long term use in CLL; however, their mechanisms of action and the factors responsible for the emergence of drug resistance have not been well defined in this leukemia. Results obtained from the present study will demonstrate whether the lymphocytolytic activity of cyclophosphamide and chlorambucil in CLL correlates with their ability to induce DNA crosslinking and with the subsequent effects on the cellular levels of NAD and ATP. This study will demonstrate whether resistance to these alkylating agents in CLL can be attributed to changes in drug transport or metabolism, the cellular levels of sulfhydryl groups or the rate of repair of drug-induced DNA crosslinks. Clinical resistance to one or both of the alkylating agents will be correlated with these biochemical findings. It is hoped that the genes responsible for drug resistance can be transferred to a sensitive fibroblast cell line, with a view to cloning this gene in the future. The results of these studies may allow the development of an assay(s), using biochemical, immunological or molecular biological studies, on leukemic cells *in vitro*, to predict which CLL patients will respond clinically to chlorambucil or cyclophosphamide and to anticipate the emergence of drug resistance.

## OLIGOSACCHARIDE PROCESSING INHIBITORS INHIBIT FUSION IN RAT L6 MYOBLASTS

*J. C. Jamieson, M. A. Spearman and J. A. Wright*

Glycoproteins have been implicated in the recognition and adhesion events of myoblast fusion (Parfett et al, (1981) Exptl. Cell Res. **136**:1-14). We have now studied the effect of oligosaccharide processing inhibitors on myoblast fusion in order to obtain further information on the nature of the oligosaccharide chains that may be important for fusion. The compounds used were 2.5mM 1-deoxynojirimycin, 1.0mM methyldeoxynojirimycin and 0.1mM castanospermine which are inhibitors of the processing glucosidases; 0.5mM deoxymannojirimycin, a mannosidase I inhibitor and 2.6 $\mu$M swainsonine, a mannosidase II inhibitor. All inhibitors prevented fusion except for the mannosidase I inhibitor, deoxymannojirimycin which had a negligible effect on the fusion reaction. Inhibition of fusion could be reversed by removal of the inhibitors from the culture medium. Alterations in cell membrane oligosaccharises were monitored by observing changes in binding of concanavalin A (ConA) and wheat germ agglutinin (WGA) to cell surfaces after treatment of cells with processing inhibitors. There was increased binding of ConA and decreased binding of WGA in the presence of all the processing inhibitors tested. However, the alterations in lectin binding could be reversed when the oligosaccharide processing inhibitors were removed from the culture medium. Creatine kinase, which is a marker for biochemical differentiation in myoblasts during fusion, was reduced in the presence of processing inhibitors except for deoxymannojirimycin. The results show that glucosidase inhibitors are most effective in blocking fusion presumably by interfering with the recognition processes that require high mannose chains on cell membrane glycoproteins that are important for fusion. Deoxymannojirimycin did not prevent fusion. This suggests that structures with $\mathrm{Man}_9$ or $\mathrm{Man}_8$ are probably of greatest importance for the recognition process involved in the fusion reaction.

Swainsonine causes the formation of hybrid structures, but does not interfere with the synthesis of high mannose chains and should not have inhibited fusion. However, the high mannose arm of the hybrid structure has been shown to interfere with the uptake of mannose terminated oligosaccharides by a membrane receptor in a macrophage cell line; a similar mechanism is proposed to explain the effect of swainsonine on myoblast fusion in the present studies.

## EFFECTS OF 3'-(CYANO-4-MORPHOLINYL)-3'-DEAMINOADRIAMYCIN (CMA) AND OTHER ADRIAMYCIN (ADR) ANALOGS ON DNA IN HT-29 HUMAN COLON CARCINOMA CELLS AND NUCLEI

*Michael I. Jesson, James B. Johnston, Uppoor G. Bhat and Asher Begleiter*

The potent adriamycin (ADR) analog, 3'-(3-cyano-4-morpholinyl)-3'-deaminoadriamycin (CMA) produces DNA-DNA crosslinks in human and murine tumor cells. The cytocidal activities of CMA, 3'-(4-morpholinyl)-3'-deaminoadriamycin (MA), their 5-imino derivatives, ICMA and IMA, and ARD, and the effects of these agents on DNA of HT-29 human colon carcinoma cells were measured. These activities were compared to determine the structural requirements for the crosslinking activity and the role of this activity in the cytocidal action of CMA. CMA was 50-fold more cytotoxic to HT-29 cells than ICMA, 300-fold more toxic than MA and 150-fold more toxic than ADR. Both CMA ad ICMA produced DNA-DNA crosslinks in HT-29 cells; however, the imino derivative was 100-fold less active than CMA. MA, IMA and ADR did not produce any DNA-DNA crosslinks. CMA showed similar crosslinking activity in HT-29 nuclei, and both cyano derivatives also produced crosslinks in isolated DNA, providing evidence that CMA does not require metabolic activation. While MA and ADR produced DNA strand breaks in HT-29 cells, this damage was not observed with CMA and ICMA. This study has provided evidence that CMA produces DNA-DNA crosslinks in HT-29 human colon carcinoma cells and that this activity may be related to the cytocidal action of this anthracycline analog. The cyanide group appears to be essential for both the crosslinking and the potent cytotoxic activity of CMA and the quinone group also appears to be involved in these activities.

## COMPARISON OF ADRIAMYCIN UPTAKE IN CHICK EMBRYO HEART AND LIVER CELLS AND MURINE L5178Y LYMPHOBLASTS IN VITRO: ROLE OF DRUG UPTAKE IN CARDIOTOXICITY

*Beverly A. Johnson, Mary S. Cheang and Gerald J. Goldenberg*

The mechanism of uptake of adriamycin was investigated in chick embryo heart and liver cells and in murine L5178Y lymphoblasts in vitro. Drug uptake at 4 C for 15 s due to rapid association accounted for a cell:medium distribution ratio of 104 ± 14 (SE) in heart cells, 10.2 ± 1.3 in liver cells, and 10.3 ± 1.5 in L5178Y lymphoblasts. On thin-layer chromatographic analysis, 98% of the radioactivity migrated with the mobility of intact drug, suggesting that drug metabolism was negligible for at least 30 min in both heart and tumor cells. A time course of drug uptake was somewhat different in heart cells compared to that noted for liver or L5178Y cells. The steady state for drug uptake was reached more promptly in heart cells; apparent equilibrium was observed at 6 min in heart cells, at approximately 20 min in L5178Y lymphoblasts, but was not attained by 25 min in liver cells. Temperature dependence of drug uptake also differed in the three cell types; drug uptake was most temperature sensitive in L5178Y cells, intermediate in liver cells, and least temperature dependent in heart cells. Separation of heart, liver, and leukemic cells into membrane and cytosol fractions demonstrated that, at 1 and 30 min, more than 75% of the drug was associated with the membrane fraction. Trichloroacetic acid extraction of cell constituents revealed that, at 1 min, the acid-soluble fraction amounted to 32 ± 2% of radioactivity in heart cells and 37 ± 2% in L5178Y cells. Ethanol extraction of these cells demonstrated that, at 1 min, ethanol-soluble components accounted for 49 ± 2% of radioactivity in heart cells and 27 ± 2% in leukemic cells. The finding of a large component of rapid association together with evidence of prompt drug binding to cellular constituents made evaluation of unidirectional drug influx impractical.

Accordingly, a investigation was undertaken of adriamycin efflux from chick embryo heart and liver cells and L178Y lymphoblasts, after the cells had been loaded with drug for various time intervals. In all three cell types, efflux was rapid down to a plateau level, representing non-exchangeable drug. As the period of time for loading cells was increased, there was a progressive rise in the level of non-exchangeable drug. Equilibration of the non-exchangeable pool occurred more rapidly in heart cells than in either liver or leukemic cells. In heart cells, the non-exchangeable pool of drug reached an apparent steady state by 12 min, whereas non-exchangeable drug continued to increase for at least 30 min in liver cells and 60 min in leukemic cells. After 1 min, intracellular adriamycin concentration was 1.98 ± 0.12 mM in heart cells, 0.18 ± 0.01mM in liver cells, and 0.18 ± 0.02 mM in L5178Y cells; after 30 min, the drug levels were 2.22 ± 0.17 mM in heart cells, 0.50 ± 0.08 mM in liver cells, and 0.58 ± 0.06 mM in leukemic cells. The higher cellular concentration of adriamycin in heart cells, relative to those found in liver and tumor cells, and perhaps the more rapid rate of equilibration of both total and non-exchangeable drug in heart cells may explain, at least in part, the marked sensitivity of cardiac tissue to drug toxicity.

## EFFECTS OF 3'-(4-MORPHOLINYL)-3'-DEAMINODAUNORUBICIN, 3'-(4-METHOXY-1-PIPERIDINYL-3'-DEAMINODAUNORUBICIN AND DAUNORUBICIN ON NUCLEAR AND POLYSOMAL RNA SYNTHESIS IN HUMAN COLIN CARCINOMA CELLS IN VITRO

*James B. Johnston, Asher Begleiter and Robert I. Glazer*

The sugar amine modified anthracycline, 3'-(4-morpholinyl)-3'-deaminodaunorubicin (MD) and 3'-(4-methoxyl-1-piperidinyl)-3'-deaminodaunorubicin (MED), are 10-fold more potent than daunorubicin (DAU) as inhibitors of RNA synthesis in human colon carcinoma (HT-29) cells *in vitro*, although they are 10-fold less cytocidal. In this study, HT-29 cells were exposed for 2 h to 5 x $10^{-8}$M MD or MED, or 5 x $10^{-7}$M DAU; under these conditions total RNA synthesis is decreased by each drug by 50%, whereas cell viability is reduced >99% by DAU, but <10% by MD and MED. Following the 2 h exposure, the cellular content of DAU was 2- to 4-fold greater than that of MED and MD, respectively. All three drugs had a similar inhibitory effect on the different nuclear RNA fractions and preferentially reduced nucleolar RNA synthesis (44-49% inhibition) compared to heterogeneous RNA synthesis (5% inhibition). Polysomal RNA synthesis was inhibited to a greater degree than nuclear RNA synthesis by all the anthracyclines, and non-poly RNA synthesis was decreased by 50-60% and poly(A) RNA synthesis by 30%. When treated cells were incubated in drug-free medium for 2 h, RNA synthesis returned to 80% of the pretreatment level in MD and DAU treated cells, but by <10% in cells treated with MED, and this difference was due to the more rapid cellular efflux of MD and DAU versus MED. Thus, MD and MED are inherently more potent inhibitors than DAU of RNA synthesis in HT-29 cells, but their reduced cytotoxicity cannot be attributed to differing effects on nucleolar or heterogeneous RNA synthesis, the nucleocytoplasmic transport of RNA, or the rate of return of RNA synthesis following drug treatment.

## 2'-DEOXYCOFORMYCIN AND CHRONIC LYMPHOCYTIC LEUKEMIA CORRELATION BETWEEN CLINICAL EFFICACY AND LYMPHOCYTE ADENOSINE DEAMINASE ACTIVITY

*James B. Johnston, Asher Begleiter, Robert I. Glazer, Linda Pugh, Peter M. Venner and Lyonel G. Israels*

Twenty-three patients with refractory B-cell chronic lymphocytic leukemia were treated with the adenosine deaminase inhibitor, 2'-deoxycoformycin, 4 mg/M$^2$ i.v. weekly for 2 to 5 weeks, followed by intermittent injections of 2'-deoxycoformycin. Six patients were highly sensitive to 2'-deoxycoformycin and showed a 40-87% (median 64%) decline in lymphocyte count following two treatments with subsequent improvements in neutrophil and/or platelet counts. Eight patients showed a >50% fall in peripheral lymphocyte count, but no improvements in other hematological parameters and 9 patients did not respond to treatment. The major toxicity was nausea/vomiting, which occurred in 13 patients and was moderately severe in 7. Other toxicities included diarrhea, alterations in taste and lethargy. Over a total cumulative period of 250 months, 10 patients had 19 episodes of infection. Frequently, these infections occurred shortly after treatment and may be related to neutrophil dysfunction by adenosine deaminase inhibition. The pretreatment peripheral mononuclear cell adenosine deaminase activity were 1.6 to 64 nmol adenosine/hr/10$^6$ cells which was lower than for control cells (70-200 nmol adenosine/hr/10$^6$ cells). However, neither the pretreatment mononuclear cell adenosine deaminase activities, nor the rate of return of activity following treatment, correlated with the clinical response. The plasma deoxyadenosine/adenosine levels rose slightly following 2'-deoxycoformycin (0.2 to 1.6 $\mu$M), but the degree of increase did not correlate with clinical response nor the incidence of drug toxicity.

## CELLULAR PHARMACOLOGY OF 3'-(3-CYANO-4-MORPHOLINYL)-3'-DEAMINOADRIAMYCIN AND STRUCTURAL ANALOGUES IN HUMAN COLON CARCINOMA (HT-29) CELLS IN VITRO

*James B. Johnston, Linda Pugh ad Asher Begleiter*

The new adriamycin (ADR) analogue, 3'-(3-cyano-4-morpholinyl)-3'-deaminoadriamycin (CMA), is the most potent anthracycline yet developed. The cellular pharmacology of CMA, 3'-(4-morpholinyl)-3'-deaminoadriamycin (MA) and their 5-imino derivatives, ICMA and IMA, were compared with ADR in a human colon carcinoma (HT-29) cell line *in vitro*.

Using a soft agar clonogenic assay, CMA was 150- to 500-fold more cytocidal than ADR, whereas MA was less potent than ADR. ICMA was 50- to 100-fold less cytocidal than CMA, but IMA was only 5- to 10-fold less potent than MA. Consistent with its greater antitumor activity, the rate of cellular efflux of CMA was slower than that of MA, although the cellular uptakes of the analogues were approximately equal. The order of cytotoxicity of the analogues correlated well with their effects on DNA synthesis, suggesting that this feature was responsible for antitumor activity. ADR preferentially inhibited E. coli RNA polymerase activity directed by poly (dADT) • poly(dADT) compared to poly (dGdC) • poly(dGdC), but this was also observed with CMA and MA and the three drugs had equal potency. Thus, CMA is similar to the antibiotic saframycin A in that its potent effects on cellular nucleic acid synthesis and cell viability depend on the presence of the cyanide group and a freely reducible quinone ring. However, unlike saframycin A, CMA does not show guanine specificity for its interaction with DNA.

## CHARACTERIZATION OF A MOUSE CELL LINE SELECTED FOR HYDROXYUREA RESISTANCE BY A STEPWISE PROCEDURE: DRUG-DEPENDENT OVERPRODUCTION OF RIBONUCLEOTIDE REDUCTASE ACTIVITY

*Grant A. McClarty, Arthur K. M. Chan and Jim A. Wright*

Hydroxyurea was used as a selective agent in culture, to isolate by a stepwise procedure, a unique mouse L cell line called LHF which exhibited a stable resistance to high concentrations of drug (5mM). LHF cells contained an elevation in ribonucleotide reductase activity which depended upon whether cells were previously cultured in the presence or absence of hydroxyurea. M1 immunoprecipitation and M2 titration experiments indicated that both ribonucleotide reductase subunits were elevated in drug-resistant cells. Interestingly, a very large drug-dependent change in the M2 activity (about a 100-fold) was observed. Studies on enzyme activity with cycloheximide and actinomycin D indicated that the hydroxyurea-dependent increase in activity required de novo protein synthesis and transcriptional activity. These results are different from other ribonucleotide reductase overproducing cell lines previously described and indicate that hydroxyurea modulates enzyme activity by an interesting mechanism.

## HYDROXYUREA-INDUCED CONVERSION OF MAMMALIAN RIBONUCLEOTIDE REDUCTASE TO A FORM HYPERSENSITIVE TO BLEOMYCIN

*Grant A. McClarty, Arthur K. M. Chan and Jim A. Wright*

Bleomycin is a commonly used chemotherapeutic agent known to cause extensive DNA damage. In this paper we show that bleomycin inhibits ribonucleotide reductase activity in mouse L-cells. The effectiveness of the drug is a result of its metal-chelating properties which enable it to inactivate the iron containing M2 subunit of the enzyme. A hydroxyurea-resistant mouse L-cell line was used to show that the degree of inhibition caused by bleomycin can be greatly enhanced if ribonucleotide reductase has been previously exposed in vivo or in vitro to agents, such as hydroxyurea, which destroy the tyrosine free radical of subunit M2. The increased effectiveness of bleomycin appears to result from a decrease in the stability of the iron center of protein M2 following exposure to hydroxyurea. These findings have important implications in terms of the use of bleomycin as an anticancer agent, especially in combination chemotherapy where it can be used with other drugs that act at ribonucleotide reductase.

## EVIDENCE THAT THE ANTITUMOR AGENT HYDROXYUREA ENTERS MAMMALIAN CELLS BY A DIFFUSION MECHANISM

*Jessica S. Morgan, David C. Creasey and Jim A. Wright*

Very little information is available about the process responsible for the uptake of the antitumor agent hydroxyurea by mammalian cells. Therefore we have investigated the transport of hydroxy[$^{14}$C]-urea into Chinese hamster ovary cells. Using a convenient and reproducible 2 min assay we found that hydroxyurea was taken up in a linear nonsaturable fashion between 0.01 mM and 100 mM drug. The $K_m$ for hydroxyurea uptake was essentially zero and the $V_{max}$ appeared to be infinite, suggesting a diffusion mechanism. The observation that intracellular drug concentrations were consistently less than medium concentrations indicated that uptake was not an active process. Experiments performed with the metabolic inhibitor sodium azide, and investigations at different assay temperatures also gave results consistent with a mechanism of drug diffusion. In total, the results obtained in this study are in agreement with the proposal that hydroxyurea enters the cell primarily by a process of diffusion. These observations provide a more complete understanding of the mode of action of this drug.

## MENADIONE INHIBITION OF BENZO(a)PYRENE METABOLISM IN WHOLE CELLS, MICROSOMES AND RECONSTITUTED SYSTEMS

*I. J. Sadowski, J. A. Wright, D. Ollmann and L. G. Israels*

The microsomal mixed function oxidase (MFO) system consisting of NADPH-dependent cytochrome P-450 reductase, multiple forms of cytochrome P-450 and a lipid component mediates the initial phase of metabolism of hydrophobic organic molecules to their polar metabolites.

Menadione is known to decrease the mixed function oxidase mediated metabolism of a number of substrates in microsomal systems. The present study examined the effect of menadione on benzo(a)pyrene metabolism in whole cells, microsomes and a semi-purified reconstituted mixed function oxidase system. Menadione had a high affinity for the NADPH dependent cytochrome P-450 reductase and acted as a competitive inhibitor of cytochrome P-450 reductase in the metabolism of benzo(a)pyrene. This was the mechanism of inhibition of aryl hydrocarbon hydroxylase by menadione in reconstituted systems. In a whole cell system and at low concentrations of menadione, depletion of reduced pyridine nucleotides was the initial inhibitory event.

## DETERMINATION OF THE AMINO ACID SEQUENCE OF BOVINE SPLEEN HEME OXYGENASE

*Brent A. Schacter, Gwynneth Offner, Val Cripps and Robert Troxler*

Heme oxygenase is an important housekeeping enzyme located in the endoplasmic reticulum that catalyzes the oxidative conversion of heme from hemoglobin and heme-proteins to bile pigment (Biliverdin) that is then excreted. In order to understand more fully the nature of the reaction mechanism, studies are underway to determine the primary amino acid structure of this enzyme; in particular, the heme-binding active site. Partially purified bovine spleen heme oxygenase has been purified to homogeneity by high performance liquid chromatography on an acetonitrile/water gradient. The purified protein was subjected to proteolytic digestion by trypsin, and the amino acid sequences of the resulting peptides are currently being analyzed on an applied biosystems gas phase protein sequencer.

## ALTERATIONS IN MICROSOMAL DRUG METABOLISM AND HEME OXYGENASE IN ISOLATED HEPATIC PARENCHYMAL AND SINUSOIDAL CELLS IN MURPHY-STURM LYMPHOSARCOMA-BEARING RATS

*B. A. Schacter and P. Kurz*

Previous studies have demonstrated that Murphy-Sturm lymphosarcoma-bearing rats have significantly decreased hepatic microsomal cytochrome P-450 and NADPH-cytochrome c reductase activity, a consequent decreased capacity for oxidative microsomal drug metabolism, and increased microsomal heme oxygenase activity. Splenic microsomes obtained from tumor-bearing rats did not display similar changes. To define the cellular locus of these changes, preparations of hepatic parenchymal and hepatic sinusoidal cells were obtained from control and Murphy-Sturm lymphosarcoma-bearing rats and examined for alterations in microsomal parameters of drug metabolism and heme oxygenase. In hepatic parenchymal cell populations, heme oxygenase activity was significantly increased in tumor-bearing rats (0.046 nmol/mg/min vs. 0.019 nmol/mg/min, control, $p<0.01$) while other microsomal parameters were all significantly decreased in activity (cytochrome P-450, 0.25 nmol/mg vs. 0.70 nmol/mg, control, $p<0.001$; NADPH-cytochrome c reductase, 24.4 nmol/mg/min vs. 42.6 nmol/mg/min, control, $p<0.005$; benzo(a)pyrene hydroxylase, 0.230 nmol/mg/min vs. 0.518 nmol/mg/min, control $p<0.001$). These results are similar to those obtained with microsomes from whole liver. Conversely, while hepatic sinusoidal cell preparations also demonstrated increased heme oxygenase acivity (0.134 nmol/mg/min vs. 0.079 nmol/mg/min, control, $p<0.01$), all other hepatic sinusoidal cell microsomal parameters were not appreciably altered in tumor-bearing animals. The results indicate that the major effect of the tumor-bearing state on hepatic microsomal heme and drug metabolism is on the parenchymal cell, and not the sinusoidal cell population.

### SYNTHESIS AND BIOLOGICAL ACTIVITIES OF 1-DEOXY-N-DEMETHYLPYRROMYCIN

*C. M. Wong, Y. L. Yan and H-Y.P. Lam*

Aklavinone was obtained by hydrolysis of crude extract from a culture broth of Streptomyces Galilgeus vir. Siwenenesis. Condensation of aklavinone with daunosamine yielded 1-deoxy-N-demethylpyrromycin. This compound was found to be active against murine leukemia P388 in vitro with a $ED_{50}$ of $3 \times 10^{-7}M$; its activity was higher than that of aclazinomycin A ($ED_{50} = 7 \times 10^{-7}$) but lower than that of adriamycin ($ED_{50} = 10^{-8}M$). The in vitro antitumor activity of these three compounds against the adriamycin resistant line P388/A1 were very similar ($ED_{50} = 3\text{-}6 \times 10^{-6}M$). Our results suggested that further studies of antitumor activity of 1-deoxy-N-demethylpyrromycin is warranted.

## B. IMMUNOLOGY

### PHENOTYPIC ALTERATIONS IN TUMORS THAT DEVELOPED FROM THRESHOLD SUBCUTANEOUS INOCULA

*Garth W. Brown, Thomas P. Lesiuk and Donna A. Chow*

Tumors obtained from the injection site of threshold subcutaneous inocula of L5178Y-F9 or SL2-5 lymphomas in syngeneic mice exhibited increased tumor frequencies and reduced sensitivities to other parameters of natural immune resistance in vivo and in vitro. An examination of the resistant phenotype of cells derived through this model of tumor progression revealed that the more aggressive in vivo grown cells were less able to inhibit natural killer (NK) cell cytolysis and to bind natural antibodies (NAb) measured through fluorescence analysis, although they could not be distinguished from the starting clones by absorption of NAb for complement-mediated lysis. The in vivo grown cells also exhibited a reduced sensitivity to hypotonic lysis, which was not detectable after preincubation at 4°C or upon exposure to sodium azide, procedures that reduced the lysis of the starting clones. The differential susceptibility of the in vivo grown cells was increased to control levels by treatment with cycloheximide or colchicine. These studies suggest that a decreased sensitivity to lysis associated with a reduced autolytic process and an increased counterlytic mechanism, in addition to a reduced antigen expression for binding of NK cells and certain NAb contribute to this resistant phenotype, which may characterize tumors that arise under the selective pressure of natural resistance mechanisms in the natural course of neoplastic development.

### ROLE OF NATURAL RESISTANCE IN TUMOR PROGRESSION

*Donna A. Chow*

Both *in vivo* and *in vitro* approaches are being taken in a search for evidence to support a natural or innate form of tumor surveillance within the framework of the variant generation and selection concept of tumor development.

*In Vivo:* Recent investigations of the regulation of tumor development in mice revealed a biphasic pattern of abrogation followed by augmentation of NR after exposure to silica or adjuvant treatment with lipopolysaccharide. These experiments suggested the complex nature of the influence of immune response modifiers on tumor progression and demonstrated clearly their ability to increase the rate of tumor development. This data provided additional evidence for roles for natural killer (NK) cells, macrophages and natural antibodies (Nab) in the defense against tumors and also in directing tumor progression. NAb binding and tumorigenicity studies in the B-cell deficient CBA/N mouse strain compared with the normal CBA/J further substantiate a role for NAb in the resistance against small tumor foci. In addition, consistent derivation through growth in vivo of tumors that exhibited a unified natural defense resistant phenotype has provided cells for future investigations of the salient features of neoplasms undergoing progression from small foci of cells.

*In Vitro:* Growth of murine tumor lines in medium containing the tumor promoter 12-0-tetradecanoylphorbol-13-acetate (TPA) followed by selective elimination on the basis of natural antibodies and complement (NAb:C) has demonstrated the essential features of tumor progression in vitro. The TPA treated cells exhibited an increased heterogeneity in sensitivity to NAb:C and after repeated selection the cells were less sensitive not only to NAb:C but also to NK cells, hypotonic lysis and NR measured as a rapid elimination of radiolabelled tumor cells. However, these variants bound more fluorescence detected NAb and exhibited reduced tumor frequencies so that in summary the data provided evidence for NAb and NK cells acting against tumors in vivo but distinguished between 1) NAb measured through complement fixation and through FACS analysis and 2) NR assayed through rapid tumor clearance and as the tumor frequency of threshold inocula.

The consistent correlation arising from both models is the inverse association of NAb binding and tumorigenicity. The expression of NAb target antigens and the focus of antitumor NR against these determinants may prove therefore to be a pivitol feature of the host tumor interaction in early tumor development.

## TOLERANCE TO DRUG-INDUCED (POLY I:C) NATURAL KILLER CELL ACTIVATION: CONGRUENCE WITH A PAVLOVIAN CONDITIONING MODEL

*Dennis G. Dyck, Arnold H. Greenberg and Timothy A. G. Osachuk*

Two experiments were conducted to assess the role of conditioning factors on the tolerance of drug-induced natural killer (NK) cell activity. A protocol in which mice were given four weekly injections of the immunostimulatory synthetic polynucleotide (poly I:C) paired with a complex environmental stimulus produced a reliable tolerance effect. The sensitivity of the observed tolerance to known decremental conditioning procedures — extinction (Experiment 1) and pre-exposure to the conditioning stimulus (latent inhibition, Experiment 2) — was investigated. The results indicated that post-treatment exposure to drug-signaling cues (i.e. extinction) significantly reversed tolerance such that NK cell activity was at a level comparable to that for controls receiving the drug for the first time (Experiment 1). In a similar fashion, pretreatment exposure to the drug-signaling cues (CS pre-exposure) inhibited the development of tolerance (Experiment 2). These results provide initial evidence that non-pharmacological manipulations of drug-signaling environmental cues can affect tolerance to the immunostimulatory effect of poly I:C, as would be expected with a conditioning analysis of such tolerance.

## ACTIVATION OF THE INOSITOL CYCLE IN THE LARGE GRANULAR LYMPHOCYTE LEUKEMIA RNK FOLLOWING CONTACT WITH AN NK-SENSITIVE TUMOR

*J. M. Gerrard, E. Hildes, E. Atkinson and A. H. Greenberg*

Stimulation of an NK-cell line by tumor cells was found to be associated with increased production of diglycerides, inositol bisphosphate and lysophosphatidic acid. Production of diglycerides and inositol bisphosphate suggests that there is a breakdown of one of the polyphosphoinositides soon after the RNK cells are exposed to the tumor cells. Neomycin, a compound which can inhibit phosphoinositide turnover, was found to inhibit both diglyceride production and RNK cell lysis of the YAC-1 tumor cells. The results suggest that activation of the inositol cycle is involved in activation of NK cells when they are exposed to tumors and may be involved in the secretion of lytic proteins from the NK cells to cause tumor lysis.

## NK-LEUKOCYTE CHEMOTACTIC FACTOR (NK-LCF): A LARGE GRANULAR LYMPHOCYTE (LGL) GRANULE-ASSOCIATED CHEMOTACTIC FACTOR

*Arnold H. Greenberg, Nasreen Khalil, Bill Pohajdak, Mike Talgoy, Pierre Henkart and F. William Orr*

A chemotactic factor was identified in the supernatants of human large granular lymphocytes (LGL) activated by a gluteraldehyde-fixed NK-sensitive tumor, K562. The factor stimulated migration of human LGL, rat alveolar macrophage (RAM), and human monocytes and neutrophils (PMN). The locomotor response was chemotactic and chemokinetic on the basis of unidirectional migration in concentration gradients. The cell producing the factor was detected exclusively in LGL-rich Percoll fraction coincident with the peak of NK lytic activity and HNK-$1^+$ cells. The monoclonal phenotype of the cell was HNK-$1^+$, partially OKT-$11^+$, OKM-$1^-$, OKT-$3^-$, OKT-$4^-$, and OKT-$8^-$. The factor was released by LGL within 20 min of incubation with $Sr^{++}$, a cation that is able to induce LGL degranulation. A powerful chemoattractant was also detected in the granules of the rat LGL leukemia, RNK. Chemotactic activity coincided with granule enzyme $\beta$-glucuronidase and cytolysin after RNK nitrogen cavitation and Percoll fractionation of subcellular constituents. The RNK granule chemoattractant induced unidirectional migration of human LGL and was also active against rat alveolar macrophages and human PMN. Anti-RNK granule antibody conjugated to Sepharose 4B was able to deplete the chemotactic activity from both K562-induced LGL supernatants and solubilized RNK granules. These observations indicate that a leukocyte chemotactic factor (NK-LCF) is present in NK cell granules and is probably released after tumor-induced granule exocytosis.

## EFFECTS OF ENDOGENOUS AND EXOGENOUS OPIOIDS ON SPLENIC NATURAL KILLER CELL ACTIVITY

*Ricky P. Kraut and Arnold H. Greenberg*

Previous work from our own and other laboratories has shown that electroshock-induced neurohormonal changes in rodents could modify host-tumor interactions by both increasing the frequency and growth rate of transplanted tumors and decreasing the elimination rate of a radiolabelled natural killer (NK) cell sensitive tumor. To test whether such neurohormonal changes could affect NK activity we subjected mice to tail electrode shock (TES) and examined in vitro splenic NK activity. We found that between 30 and 60 min after TES there is a significant but transient suppression of their splenic NK activity. To determine whether TES-induced endogenous opioids might be involved in this suppression mice were given intraperitoneal injections of the opioid antagonists naloxone or naltrexone before or at the end of the TES session. These drugs prevented NK suppression. In a further test of the hypothesis that opioids alter NK activity mice were given a single intraperitoneal injection of morphine or [D-Ala$^2$-Met$^5$]-$\beta$-endorphin, a relatively stable analogue of $\beta$-endorphin, an endogenous opioid. Contrary to expectations these opioids enhanced splenic NK activity. Our interpretation of these results is that shock-induced NK suppression may not be mediated by endogenous opioids and that the effects of naloxene and naltrexone on NK activity may not be related to their opioid antagonist properties. On the contrary, opioids may participate in a homeostatic rebound from suppression mediated by other neurohormonal mechanisms activated during TES.

## DEVELOPMENT AND CHARACTERIZATION OF MONOCLONAL ANTIBODIES OF BOVINE BRAIN CALCINEURIN

*H-Y. P. Lam*

Three monoclonal antibodies (MAb's) against bovine brain calcineurin, a $Ca^{++}$-calmodulin dependent phosphatase, have been developed and characterized. Among these antibodies, two are $\alpha$-subunit (60,000 Mr) specific and one is $\beta$-subunit (19,000 Mr) specific. These antibodies also cross-react with similar proteins obtained from brains of human, rat and mouse. The methodology for raising these antibodies and their properties are described in the journal Hybridoma 6:1-8, 1986.

## A NEW INTERPRETATION OF TUMOR PROGRESSION

*S. T. Lee, K. Harrop and F. Paraskevas*

One of the greatest paradoxes in immunology is the ability of tumor to grow progressively in an otherwise immunocompetent host. Several mechanisms have been suggested to explain the ability of tumor cells to "escape". Perhaps the most widely accepted interpretation is the development of suppressor T cells which "turn off" the immune responses and allow tumor progression. We have shown previously that serum from mice 6 hours after immunization (6HS) with foreign, allogenic or even syngeneic tumor antigens, contains a unique and highly immunogenic form of processed antigen which represents complexes of Ig and antigen. Evidence showed that 6HS represents a mediator of an immunoregulatory pathway which we have called antisuppression, named simply because it interferes with suppressor T cell function and allow the immunity to develop.

We present evidence here that 6HS, produced in mice to $10^7$ 1509a tumor cells, when injected together with suppressor cells into the mice can interfere with the suppressor cell function in a DTH response to tumor, ie. to reverse suppression to immunity. However, if a small dose of live tumor cells ($10^2$) was given before the induction of 6HS by $10^7$ cells, the antisuppression activity of the 6HS was abrogated. We conclude that $10^2$ live tumor cells which mimics the early stage of tumor growth, prevents the development of antisuppressor cell pathway and opens the way for suppression, thus allowing the tumor to grow progressively.

## MACROPHAGE T CELL INTERACTION: INDUCTION IN VITRO OF A MEDIATOR WITH POTENT ANTISUPPRESSOR ACTIVITY

*J. Maeba, S. T. Lee and F. Paraskevas*

A simple in vitro method is described for the induction of a potent mediator that interferes with suppressor cell function. The mediator consists of three easily identifiable components, antigen, class II determinants and Ig that form a unqiue kind of a complex similar to, or identical with the complexes detected in vivo within 3-6 hours after immunization. The formation of the antisuppressor mediator in vitro takes place in two steps: the first involves a macrophage T cell interaction which generates an "intermediate product" containing antigen and class II determinants. In the second step, the addition of small amounts of immunochemically purified IgG from normal mouse serum to the macrophage T cell supernate generates potent antisuppressor activity, which is assayed by the conversion of suppression to immunity. It is suggested that the IgG interacts with the "intermediate product" giving rise to a complex identical to that found in vivo 6 hours after immunization. No activity is detected when IgG is added to a supernate of antigen fed macrophages in the absence of T cells. Furthermore, the T cell plays an additional important role in the formation of the complexes since it restricts the source of the IgG that will generate the antisuppressor activity. In other words, the antisuppressor function is detected only if the IgG matches the donor of the T cell in the IgH locus. The T cell involved in the formation of the complex is the $\text{Lyl}^+$ subpopulation. This method should allow elucidation of the genetic, cellular and molecular mechanisms in the activation of this important T cell pathway.

## A PHENYL-β-GALACTOSIDE-SPECIFIC MONOCLONAL ANTIBODY REACTIVE WITH MURINE AND RAT NK CELLS

*Veronica E. Miller, Alain E. Lagarde, B. Michael Longenecker*

The phenyl-β-galactoside ($\Phi$ -β-gal)-specific monoclonal antibody (mAb) 59H.8 cross-reacts with the terminal disaccharide structure of the asialo $\text{GM}_1$ (AGM1) molecule. It was found to react with $\Phi$ -β-gal determinants on murine and rat splenic natural killer (NK) cells, as measured by complement depletion studies. Flow cytometric analysis identified the antigen on two IL 2-dependent cloned murine NK cell lines and the rat large granular lymphocyte leukemia RNK. We have compared the 49H.8 reactivity to that of anti-AGM1 antisera (α-AGM1) on NK cells and a panel of NK related killer cells, including bone marrow-derived killer cells, lymphokine-activated killer cells (LAK), and anomalous killer cells (AK). We found that the 49H.8 specificity closely paralleled that of α-AGM1. When tested against Con A-reactive T cells, the 49H.8 mAb was less reactive than the α-AGM1, indicating that it may be a more specific marker for splenic NK populations than the α-AGM1.

## INHIBITION OF ANTISUPPRESSION DURING THE ACUTE GRAFT-VERSUS HOST REACTIONS: A MECHANISM FOR GVH-ASSOCIATED IMMUNOSUPPRESSION

*F. Paraskevas, J. Garter, J. Maeba and S. T. Lee*

Profound suppression of both humoral and cell-mediated immunity is a significant systemic effect of the graft-versus-host reaction. Although no complete explanation has been advanced for this effect, suppressor cells have been implicated. The data presented in this paper indicates that acute GVHR in $F_1$-hybrid mice severely disrupts the function of the antisuppressor T cell pathway at both its induction and effector stages. Results showed that within three weeks of induction of the reaciton, $Lyl^+$-T antisuppressor inducer cell lost its ability to generate the serum factor which mediates antisuppression. In vitro, this mediator normally activates an Ly2 $^+$T cell which inhibits suppressor T cell function. The data revealed that $Ly2^+$ T cells collected 2 weeks after induction lost their ability to be activated by antisuppressor mediator produced in normal mice and were thus unable to function as antisuppressor effector cells. The antisuppressor mediator is normally taken up by $Ly2^+$ T cells. This depends on the presence of Ia antigens on the surface of these cells. Experiments showed that these antigens were absent from T cells derived from mice with GVHR. This finding may provide an explanation for the inability of these cells to function as antisuppressor effectors. Antisuppression is an important T cell pathway intimately associated with the regulation of immune function. The abrogation of its activity causes unrelenting suppressor T cell activity. It is possible that the immunosuppression which arises in mice with GVHR may stem, in part, from unopposed suppressor T cell activity resulting from widespread interference by the reaction with a pathway which normally regulates suppressor cell activity.

## THE MECHANISM OF ENHANCEMENT OF ANTIBODY FORMATION BY LOW DOSES OF CYCLOPHOSPHAMIDE

*F. Paraskevas, S. T. Lee and J. Maeba*

Low doses of cyclophosphade (CY) enhance both the humoral and cell mediated responses. The potentiating effect of CY on the immune response has been attributed to interference with the suppressor pathway due to elimination of a CY sensitive suppressor T cell.

A systematic re-examination of the mechanism of action of CY in the enhancement of antibody response in vivo against sheep erythrocytes (SRBC) showed that it enhances the IgG antibody response and the enhancement is drug and antigen dose dependent. Marked enhancement (over 200-fold) of the IgG antibody response was observed with doses of CY significantly lower than those previously used (1 mg/kg of body weight). This effect was particularly pronounced for low or subimmunogenic doses of antigen. The potentiatig effect of CY was abolished upon reconstitution of CY treated mice with T cells and specifically the $Lyl^+$ subpopulation. CY treated mice generated a potent enhancing factor within 6 hours after immunization with subimmunogenic doses of SRBC that are totally ineffective in normal mice. The factor consists of a unique form of complexes of antigen and Ig, previously described from our laboratory. As with the CY, the enhancing factor markedly enhances the IgG antibody response to subimmunogenic doses of antigen. These complexes have also been shown to interfere with suppressor cell function (Cell Immunol. **92**:53, 1985), and in the CY treated animals low or subimmunogenic doses of antigen generate potent antisuppressor activity. This effect of CY is also abolished after reconstitution with $Lyl^+$ T cells. CY treatment did not interfere with the generation of effector supressor T cell induced by low antigen doses.

Taken together, these results suggest that CY releases antisuppression from normal inhibitory control, by eliminating (or activating) an $Lyl^+$ T cell. As a result, antisuppression is activated by suboptimal doses of antigen giving rise to prominent antibody responses. The induction of suppressor cells by low antigen doses is not affected by CY treatment.

## COMPARATIVE ANALYSIS OF NATURAL KILLER CELL AND MACROPHAGE RECOGNITION OF CONCANAVALIN A-RESISTANT CHINESE HAMSTER OVARY CELLS: ROLE OF MEMBRANE OLIGOSACCHARIDES

*Bill Pohajdak, Kwok-Choy Lee, Isamu Sugawara, Veronica Miller, Jim A. Wright and Arnold H. Greenberg*

A mutation rendering Chinese hamster ovary (CHO) cells concanavalin A (Con A) resistant (Con $A^R$) resulted in enhanced binding and susceptibility to lysis by natural killer (NK) cells. In the present study altered cell surface carbohydrate expression on the con $A^R$ $C^R$-7 cell line was demonstrated. This could be detected by flow cytometry with the use of fluorescein isothiocyanate-conjugated lectins Con A, wheat-germ agglutinin, and peanut agglutinin, and by a radio-labelled monoclonal antibody (49H.8) that recognizes a phenyl-P-galactose determinant. Two other independently selected Con $A^R$ CHO lines ($BC^R$-2 and $EC^R$-1) also exhibited increased NK cell reactivity, which suggests that a similar and, likely, a single mutation has altered the phenotype of these cells. Tunicamycin, an inhibitor of N-linked glycosylation, was able to reverse the binding to the CHO lines with the use of conditions that did not affect protein or DNA synthesis. The mutation rendering the $C^R$-7 line Con $A^R$ and more sensitive to NK cell lysis and binding resulted in reduced killing and adhesion by activated bone marrow-derived macrophages from DBA/2J and CBA/CaJ mouse strains. Inhibition of macrophage and NK cell lysis by simple monosaccharides was demonstrated; however, macrophage killing was inhibited only by D-mannose, whereas NK cell lysis was reduced by all sugars tested. Neither macrophage nor NK cell adherence to tumor monolayers was affected by any of the monosaccharides. These results suggest that complex N-linked oligosaccharides are important for NK cell and macrophage binding and lysis.

## REGULATION OF ANTI-SUPPRESSION BY GENES OF THE Igh LOCUS

*S. Uniyal and F. Paraskevas*

Within 6 hours after immunogenic stimulation the serum (6HS) of mice contains a unique form of processed antigen which represents complexes of Ig and antigen and possesses potent anti-suppressor ($T\alpha s$) function. We present here evidence that their formation is Igh restricted. Sublethally irradiated mice are unable to generate $T\alpha s$ activity but do so when reconstituted with syngeneic T cells. When CB.20 (H-$23^d$, Igh-$1^b$) mice are reconstituted BALB/c T cells (H-$2^d$, Igh-$1^a$), $T\alpha S$ activity is not generated unless trace amounts of

BALB/c IgG, or IgG from other Igh-$1^a$ strains is added to the 6HS. BAB.14 (IghC$^a$-C$^b$) IgG was also effective. In the reverse experiment when BALB/c mice are reconstituted with CB.20 T cells, only IgG from Igh-$1^b$ haplotypes was effective while BAB.14 IgG was not. In reconstitutions of CAL-20 (H-$2^d$, Igh-$1^b$) or CB.20 mice with T cells from the other strain, CBAL (IghV$^d$-C$^b$) IgG could generate T$\alpha$S activity only when CAL-20 T cells were used but not CB.20. The F(ab') 2 fragment was equally efficient as the whole IgG in generating T$\alpha$s activity.

In conclusion, complete T$\alpha$s activity is generated only if the IgG matches the T cell at the IghV locus. It is postulated that the generation of the complexes with T$\alpha$s activity depends on idiotype-anti-idiotype interactions between IgG and a T cell derived component.

## C. MOLECULAR BIOLOGY

### MULTI-STAGE FRIEND ERYTHROLEUKEMIA: INDEPENDENT ORIGIN OF TUMOR CLONES WITH NORMAL OR REARRANGED p53 CELLULAR ONCOGENES

*Virginia Chow, Alan Bernstein, Sam Benchimol and Michael Mowat*

The erythroleukemia induced by Friend virus complex in adult mice is a multi-stage malignancy characterized by the emergence, late in the disease, of tumorigenic cell clones. We have previously shown that a significant proportion of these clones have unique rearrangements in their cellular p53 oncogenes. The clonal relationships among Friend tumor cells isolated in the late stages of Friend erythroleukemia were analyzed by examining the unique integration site of Friend murine leukemia virus (F-MuLV) and the unique rearrangement in their cellular p53 oncogene. The majority of clones isolated from individual mice infected with Friend virus were clonally related as judged by the site of F-MuLV integration. However, Southern gel analysis of DNA from individual Friend cell clones indicated that all of the clones with a normal p53 gene from the same mice were clonally related, but were unrelated to the Friend cell lines with a rearranged p53 gene. These results suggest that Friend tumor cells with rearrangements in their p53 gene arise as the result of a unique transformation event, rather than by progression from already existing tumor cells with a normal p53 gene. They also suggest that such rearrangements in the p53 gene confer a strong selective advantage to these cells in vivo.

### EFFECT OF ANDROGENS ON mRNA FOR A SECRETORY PROTEIN OF RAT DORSOLATERAL PROSTATE AND SEMINAL VESICLES

*Janice Green Dodd, Christophe Kreis, Patricia C. Sheppard, Andre Hamel and Robert J. Matusik*

The androgen dependence of a highly abundant mRNA found in the rat dorsolateral prostate and seminal vesicles has been investigated using a complementary DNA clone from a rat dorsal prostate library. The 1.5 kilobase (kb) mRNA codes for a 52000 Da tanslation product which processed to 49000 Da in the presence of microsomal membranes. This product appears to correspond to the previously described SVS II protein secreted by rat seminal vesicles and can be immunoprecipitated with anti-SVS II antiseum. Dot hybridization assays indicated that the mRNA is abundant in the dorsal and lateral prostate glands and in seminal vesicles but not in the ventral prostate, coagulating gland or other non-accessory sex tissues. Castration of mature male rats reduces the 1.5 kb mRNA 10-fold in the seminal vesicles and 7-fold in the dosolateral prostate in 9 days. Androgen administration to one-week castrates returned the mRNA level to normal in both tissues within 48 h. The levels of the 1.5 kb mRNA are very similar in the dorsolateral prostate and seminal vesicles at maturity but distinct patterns of developmental regulation of this gene exist in the two tissues. Between 3 and 6 weeks of age, the level of the 1.5 mRNA increases approximately 3-fold in the dorsolateral prostate while the increase in the seminal vesicles is more than 600-fold.

## H-RAS TRANSCRIPTIONAL ACTIVATION AND METATASIS FORMATION

*Sean E. Egan, Grant A. McClarty, Jim A. Wright and Arnold H. Greenberg*

It has been shown that NIH/3T3 but not C127 cells transfected with either HSV DNA or T24 H-ras are capable of forming experimental and spontaneous metastases in nu/nu mice (J. Cell. Biochem., Supplement 9C, 1985, Abst. #1180, pp20). In our study, C3H 10T 1/2 mouse cells were transfected with T24 H-ras inserted into pSV2neo, and selected in G418 sulphate. G418-resistant colonies were picked with both refractile and flat morphology. The morphologically transformed colonies gave rise to highly tumorigenic and metastatic lines (in nu/nu and C3H mice), whereas the phenotypically flat NR3 cell line was poorly tumorigenic and produced only rare experimental lung metastases. Four cell lines derived from these NR3 metastases (NR3.IL-A,B,D), were tumorigenic and metastatic. Four out of five of the original transfectants contained elevated levels of H-ras transcripts by Northern blotting, whereas NR3 had very low levels (comparable to 10T1/2). The four NR3.IL metastases expressed high levels of H-ras, perhaps indicating that selection for transcriptionally activated cells had occurred during metastases formation. In addition, four radiation induced transformants of 10T 1/2 which were tumorigenic in C3H mice, were not metastatic. No activated ras sequences were detected in these lines. These results indicate that transcription of activated H-ras sequences in 10T 1/2 transfectants can result in tumorigenic transformation as well as expression of the metastatic phenotype. We speculate that expression of activated ras may be necessary but not sufficient for development of the metastatic phenotype.

## EXPRESSION OF THE c-myc PROTOONCOGENE IN HUMAN PROSTATIC CARCINOMA AND BENIGN PROSTATIC HYPERPLASIA

*William H. Fleming, Andre Hamel, Robert MacDonald, Ernest Ramsey, Norman Pettigrew, Brian Johnston, Janice G. Dodd and Robert J. Matusik*

We have examined the level of c-myc transcripts in prostate tissue obtained from patients with both benign prostatic hyperplasia and adenocarcinoma of the prostate. A significantly higher level of c-myc transcripts is observed in patients with adenocarcinoma ($p < 0.05$). In addition, a subset of patients with adenocarcinoma had levels of c-myc transcripts 2-fold higher than the mean level for this group. These preliminary results indicate that the investigation of c-myc levels as a prognostic indicator in prostatic carcinoma is warranted.

## REGULATION OF PROSTATIC GENES: ROLE OF ANDROGENS AND ZINC IN GENE EXPRESSION

*R. J. Matusik, C. Kreis, P. McNicol, R. Sweetland, C. Mullin, W. H. Fleming and J. G. Dodd*

Gene expression in the rat dorsolateral prostate gland has been studied using cloned cDNA probes to the most abundant expressed mRNAs. One cDNA clone (pM-40) corresponds to two closely homologous mRNAs of about 880 nucleotides which code for two proteins of 23 and 21 Kilodaltons (kDa). At least the 23-kDa protein contains a signal peptide. Another clone (pRWB) corresponds to a 1550-nucleotide mRNA which codes for a 52-kDa protein which also contains a signal peptide. The steady-state levels of these specific mRNAs increase in the dorsolateral prostate with sexual maturation. In castrated mature male rats, the M-40 mRNAs are inducible either by androgens or zinc, while the RWB mRNA is only responsive to androgens. In situ cDNA-mRNA hybridization histochemistry has been used to study the localization of the M-40 and RWB gene transcripts. Both M-40 and RWB gene transcripts. Both M-40 and RWBmRAs are most abundant in the epithelium of the lateral tip of the dorsolateal prostate. Following castration, the RWBmRNA decreses, while the M-40 mRNAs continue to be expressed in isolated areas of the epithelium. These castration-resistant cells maintain normal morphology in the absence of androgens.

## DELETION OF 5'-CODING SEQUENCES OF THE CELLULAR p53 GENE IN MOUSE ERYTHROLEUKEMIA: A NOVEL MECHANISM OF ONCOGENE REGULATION

*Benjamin Rovinski, Donald Munroe, Jim Peacock, Michael Mowat, Alan Bernstein and Samuel Benchimol*

The p53 gene is rearranged in an erythroleukemic cell line (DP15-2) transformed by Friend retrovirus. Here, we characterize the mutation and identify a deletion of ≃3.0 kilobases that removes exon 2 coding sequences. The gene is expressed in DP15-2 cells and results in synthesis of a 44,000-dalton protein that is missing the N-terminal amino acid residues of p53. The truncated protein is unusually stable and accumulates to high levels intracellularly. Moreover, it appears to have undergone a change in conformation as revealed by epitope mapping studies. This study represents the first description of an altered p53 gene product arising by mutation during neoplastic progression and identifies a region in the p53 protein molecule that plays a role in determining p53 stability in vivo.

## D. HEMATOLOGY

## AN ENZYME-LINKED IMMUNOSORBENT ASSAY FOR 6-KETO PGF$_{1\alpha}$

*John C. Docherty and Jon M. Gerrard*

An enzyme-linked immunosorbent assay fo 6-keto prostaglandin F$_{1\alpha}$, a stable metabolite of prostacyclin, has been developed. The assay allows quantitation of 6-keto PGF$_{1\alpha}$ in the range 1-200 pg/0.1 ml and shows very low cross reactivity to nine other prostaglandins. Dose dependent stimulation by thrombin of 6-keto PGF$_{1\alpha}$ formation in human endothelial cells in culture has been used to verify the assay. Quantitation by the enzyme linked immunosorbent assay agrees closely with determination by radioimmunoassay.

## INHERITED PLATELET-STORAGE POOL DEFICIENCY ASSOCIATED WITH A HIGH INCIDENCE OF MYELOPROLIFERATIVE DISEASE

*Jon M. Gerrard, Esther D. Israels, Agnes J. Bishop, Marlis L. Schroeder, Laura L. Beattie, Daniel Walz, Arnold H. Greenberg, Mano Ray and Lyonel G. Israels*

A family with an inherited bleeding disorder extending over four generations, and multiple cases of myeloblastic and myelomonoblastic leukemia was studied. Ten members of the family had, by history, a hemorrhagic diathesis. There were three documented cases of myeloblastic leukemia, two documented cases of myelomonoblastic leukemia and two more cases of leukemia by history. In four of the cases the bleeding diathesis clearly antedated the leukemia, in two by many years. The bleeding disorder is characterized by a long bleeding time, abnormal platelet aggregation, low platelet ADP and decreased numbers of platelet dense bodies consistent with a storage pool deficiency. This congenital storage pool deficiency is associated with a high incidence of acute myeloblastic leukemia in this family.

## IN VIVO MEASUREMENT OF THROMBOXANE $B_2$ AND 6-KETO-PROSTAGLANDIN $F_{1\alpha}$ IN HUMANS IN RESPONSE TO A STANDARDIZED VASCULAR INJURY AND THE INFLUENCE OF A SINGLE DOSE OF 600 MG ASPIRIN

*Jon M. Gerrard, Sandra Singhroy and John C. Docherty*

Bleeding times were performed on 23 normal volunteers before and 2, 24, 48, 72 and 336 hours after 600 mg aspirin. Blood oozing from the site of the bleeding time incision was collected into heparinized capillary tubes containing indomethacin, the plasma separated, the prostaglandins extracted by passage through Sep-Paks and then assayed by enzyme-linked immunoabsorbent assay. The mean level of thromboxane $B_2$ in bleeding time blood was 3.4 ± 0.5 ng/ml during the first five minutes. The mean production of 6-keto-PGF$_{1\alpha}$ was 16.3 ± 2.6 pg/min. Following ingestion of aspirin, production of thromboxane in vitro in response to collagen fell by 95% from 205 ± 35 ng/ml to 10.2 ± 2.1 ng/ml, while thromboxane $B_2$ levels in bleeding time blood fell by 82% (from 3.4 to 0.6 ng/ml) and 6-keto-PGF$_{1\alpha}$ production in bleeding time blood decreased by 64% (from 16.3 to 5.8 pg/min). Recovery of 6-keto PGF$_{1\alpha}$ in bleeding time blood was faster (80% of control levels by 72 hours) than recovery of thromboxane $B_2$ in response to collagen, or in bleeding time blood (25% and 50% of control levels at 72 hours respectively). The results show that 600 mg aspirin inhibits production of both platelet thromboxane and vascular prostacyclin and that recovery of vascular prostacyclin levels occurs faster than recovery of platelet thromboxane.

Bleeding times were also performed on 14 chronic smokers and 18 non-smokers who had taken no non-steroidal anti-inflammatory drugs for the previous two weeks and the blood oozing from the bleeding time incision collected and analyzed for 6-keto-PGF$_{1\alpha}$ and thromboxane $B_2$. Mean production of thromboxane $B_2$ in bleeding time blood was significantly higher in smokers (5.3 ± 0.9 ng/ml) than in non-smokers (2.9 ± 1.7 ng/ml), while production of 6-keto-PGF$_{1\alpha}$ was slightly decreased in smokers (13 ± 2.9 versus 18.2 ± 3.7 pg/min for non-smokers.

## STUDIES ON THE CONTRACTILE ACTIVITY OF PLATELETS

*Sara J. Israels*

Blood platelets, in association with the plasma protein fibrin, are responsible for forming the clot that stops bleeding when a blood vessel is injured. Platelets bind fibrin by means of glycoprotein receptors embedded in the plasma membrane, to form the clot. Platelets also contain a contractile cytoskeleton which allows contraction of the clot as the platelet pulls the fibrin, compacting it and opening the blood vessel again once bleeding has stopped. The focus of this investigation is the interaction of the fibrin strands with the membrane glycoproteins (glycoproteins IIb and IIIa) and the platelet's contractile cytoskeleton. To do this we use monoclonal antibodies directed against the glycoproteins and at components of the cytoskeleton. The monoclonal antibodies have been tagged with colloidal gold particles to make them visible on electron microscopic sections of single platelets or platelet fibrin clots. we have seen that glycoprotein IIb/IIIa redistributes when single platelets are stimulated and we are now investigating the redistribution of these receptors within a clot. This will advance our understanding of how clots are formed and how they contract.

We have also been interested in patients with platelet abnormalities that affect clot contraction. We will seek an explanation of the platelet defects by examining the distribution of glycoproteins on these abnormal platelets.

Studies by other investigators had suggested that clot contraction in neonates was abnormal, but we have recently completed a quantitative evaluation of clot contraction in cord blood which showed no difference between neonatal platelets and those of adult controls in their ability to facilitate clot contraction.

## STUDIES OF PROTEIN C AND PROTEIN S DEFICIENCY IN CHILDREN WITH STROKES

*Sara J. Israels*

Protein C and its cofactor protein S are naturally occurring anticoagulants that regulate the clotting cascade by inactivating two of the factors necessary for clot formation (Factors V and VIII). Deficiency of either protein is associated with increased risk of spontaneous clot formation or excessive clot formation following trauma or surgery.

Our clinical studies have identified two infants presenting with cerebrovascular accidents with deficiencies in these proteins; one protein C deficient and one protein S deficient. In collaboration with Pediatric Neurology we are now examining a larger population of children with a history of stroke to determine whether deficiency of protein S or C is more common in this group than in the general pediatric population.

## DIFFERENTIAL EFFECTS OF SPERMINE OR AGGREGATION, INOSITOL PHOSPHATE FORMATION AND PROTEIN PHOSPHORYLATION IN HUMAN PLATELETS IN RESPONSE TO THROMBIN, ARACHIDONIC ACID AND LYSOPHOSPHATIDIC ACID

*Sara J. Israels, Jon M. Gerrard and Pauline Robinson*

Platelet aggregation stimulated by thrombin, arachidonic acid or lysophosphatidic acid is associated with rapid phosphorylation of two platelet proteins, myosin light chain and a

47 kDa protein. The polyamine, spermine, inhibited platelet aggregation stimulated by all three agents. Spermine inhibited thrombin-stimulated phosphorylation of myosin light chain and the 47 kDa proteins as well as thrombin-induced production of the inositol phosphates and phosphatidic acid. In contrast, spermine did not inhibit phosphorylation of either protein or the formation of inositol phosphates and phosphatidic acid in response to arachidonic acid or lysophosphatidic acid. Although spermine has been demonstrated to inhibit both phosphatidylinositol-specific phospholipase C and calcium-dependent protein kinases in cell free systems, these results suggest that, in the intact platelet, spermine does not directly inhibit these enzymes. Inhibition of aggregation stimulated by arachidonic acid and lysophosphatidic acid is secondary to interference with platelet-platelet interaction but not with platelet activation. In contrast, spermine inhibits thrombin-induced platelet activation. This thrombin-specific inhibition may be related to interference with the binding of thrombin to its receptor or to its catalytic substrate on the cell surface.

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# LIBRARY

**Librarian** — *Donna Chornenki*

The Manitoba Cancer Foundation Library joined the computer age this year with the addition of an I.B.M. micro computer. The computer is being used to search online the United States National Library of Medicine's databases, the Medlar System. This is being done through the Canada Institute for Scientific and Technical Information. The operation of online searching has added the capabilities of immediacy of information, increased accuracy, in-depth searching and greater flexibility in search strategy as a new resource to our Library.

The Library continues to increase its holdings: Book accessions to date 3,196, Bound journals 2,185, Journal holdings 108 were received on a regular basis.

The library committee continues to place marked emphasis on journal material. Focusing on this type of collection allows the Library current literature and a wider scope of information within our budget.

During the summer of 1986 the Library received a Manitoba Careerstart grant from the Manitoba Jobs Fund. This enabled the Library to hire a Library Technician (recent graduate) to spend 8 weeks assisting in cataloguing, establishing a new catalogue system for the books, as well as a new card catalogue.

A volunteer program was established in the library. Volunteers were selected through the Volunteer Services of the Manitoba Cancer Treatment and Research Foundation. With the help of the Co-ordinator of Volunteers a training program was set up. This invaluable contribution to the Librarian allowed her to offer more time and services to the Physicians and Researchers on staff.

The Manitoba Cancer Foundation Library continues to be recognized as the largest source of oncology literature and information housed in a medical library in the province of Manitoba. Owing to this the Library continues to receive increasing numbers of inter-library loan requests. These are filled at no cost to the borrowing libraries which belong to the Manitoba Health Libraries Association. In return these Libraries offer the Foundation Library access to their collections. Through this assocation the Foundation Library participates in a Union list of serials and books which is an invaluable resource of easily accessible materials.

## THE CANADIAN CANCER SOCIETY PATIENT SERVICES PROGRAM

The volunteer services provided by the Canadian Cancer Society at the Manitoba Cancer Treatment and Research Foundation continue to grow and enhance the quality of life of cancer patients throughout Manitoba.

**Lennox Bell Lodge** — For cancer related patients staying at the lodge the Canadian Cancer Society now offers an increased discount of 50% for people with no other form of coverage.

**Volunteer Driver Program** — The original three masonic cars were replaced with new *air conditioned* cars. Five volunteer driver cars now boast telephones.

**Reach to Recovery from breast cancer** — These trained visitors are seeing 90% of the mastectomy patients in Winnipeg.

**CanSurmount** — Trained CanSurmount visitors are visting informally in three treatment areas of the clinic; chemotherapy, radiotherapy as well as in the head and neck clinic.

**Refreshment Service** — Our ladies have served an increasing number of approximately 4000 refreshments each month. This program was enhanced with the help of nine junior girls who assisted the ladies during holiday periods.

**Wig Service** — Approximately 300 refurbished wigs and 100 turbans were distributed to ladies suffering hair loss from cancer treatment. $2,000 was used to buy new wigs for children.

**Jeffrey's Folks** — The support group for parents of children with cancer was active in assisting with the Camp for Children with Cancer and Their Siblings, which was totally funded by the Canadian Cancer Society. Patient Services also provided dozens of home baked cookies for the camp.

**The New Voice Club** — At their request this laryngectomy group became an emotional support group of the Patient Services program.

**Financial Assistance Program** — Established with the philosophy that no patient miss the opportunity of treatment due to financial difficulties, the assistance program covers the cost of accommodation, rural gas or bus fare for needy rural patients. An increased number of patients receiving bone marrow transplants out of province were also assisted.

**Professional Funding** — Several Manitoba Cancer Treatment and Research Foundation Oncology professionals obtained assistance to attend cancer related educational workshops.

**Public Open Meetings** — Two educational open meetings were sponsored by Patient Services providing updated cancer information to the public by oncology specialists.

## VOLUNTEER SERVICES

**COORDINATOR:** Elaine Hickerson, B.A.

**SUPPORT STAFF:** Anneliese Friedle

In 1986, 143 volunteers worked 10,414.25 hours at the Manitoba Cancer Treatment and Research Foundation, increasing the number of volunteers in existing programs. Volunteers were recruited and trained for new positions in the library, the chemotherapy reception desk and the radiotherapy treatment floor.

Recruitment took place through service club newsletters, T.V. Facts, Community Calendar, the University of Winnipeg Newspaper and radio station and the Volunteer Centre newspaper column and television advertisement.

Sixteen summer volunteers enabled us to maintain our volunteer services while many regular volunteers were on vacation. During the Christmas vacation period, 17 students worked 97.5 hours. The Canadian Cancer Society provided pinafores for teen volunteers working in the lounge.

During the year many volunteers took advantage of training opportunities. In January, 33 volunteers toured the Paul H. T. Thorlakson Medical Support Building. In February several volunteers attended the C.C.S. Fund Raising Conference. In April, 43 volunteers participated in an evening orientation to the M.C.T.R.F. at which time Beverly Glenday, D.O.N. and Heather Doherty, R.T.T. gave in depth tours of the chemotherapy and radiotherapy treatment areas. Donna Gorbestrof, a volunteer from Lennox Bell Lodge provided information about that facility. Twelve volunteers and the coordinator attended the Cancer Society training seminar for volunteers who offer support to patients in the terminal stage of their disease.

Volunteer Services provided personnel for three fund raising activities — the Canadian Cancer Society Daffodil Day Sale at the Foundation, the Health Sciences Centre, the Rehab Hospital and Women's Hospital; the Nursing Education Fund Sale and the United Way Campaign at the Foundation.

Herbies Corner was published four times in 1986. Our volunteer editor gave 58.5 hours to assemble those newsletters. The coordinator and volunteer editor attended a workshop on newsletter preparation sponsored by the Volunteer Centre.

The Christmas Hamper project generated a great deal of enthusiasm. The committee was co-chaired by a volunteer and a staff member. Nine volunteers worked on the project and 25 hampers were packed. Financial support came from the Transcona Optimists, Elmwood Sports Club, Manitoba Paramedical Association, M.O.N.A. Local 36, the C.C.S. Drivers and 18 individual donors. Staff of the Manitoba Cancer Foundation donated groceries and money. Total income was $1,225.00, and total expenses were $1,120.55.

Volunteer appreciation and recognition was given during National Volunteer Week, April 12-18. Dr. L. G. Israels, Executive Director of the Manitoba Cancer Foundation, and Mr. Murray Bater, Executive Director of the Canadian Cancer Society (Manitoba Division) expressed their appreciation during a tea held in honor of Volunteer Week. A lunch was held for the summer students at the end of August at which time representatives of the Manitoba

Cancer Foundation and the Canadian Cancer society expressed their appreciation for the work done by these students.

The volunteer programs at the Foundation have been appreciated by patients, their families and the staff. We will continue to look for new ways to utilize the skills and time offered by our volunteers.

## VOLUNTEERS 1986

George Ackerman
Ella Adams
Judi Adams
Livvy Aftanas
Kay Ahoff
Dela Bagshaw
Jodi Bagshaw
Helen Ball
Paul Bergman
Audrey Bird
Jan Blair
Margaret Bonar
Margaret Booth
Mary Bosman
Bonnie Bowcott
Harjit Brar
Mary Brennan
Marjorie Brotheridge
Lisa Buechert
Marion Burwash
Margaret Campbell
Mary Carey
June Carter
Herschelle Carvery
Mae Chatfield
Tammy Chesley
Marjorie Currie
Randy Dalton
Lillian Danish
Natalie Davidson
Sandra Davies
Jennifer Dodds
Dean De Sousa
Rosella Genik
Cecile George
Alison Glenday
Noreen Gillanders
Esther Ginpil
Fanny Goldenberg
Myrna Hall
Angie Harriott
Norma Haslam
Diane Haufschild
Fred Hayward
Lesli Hermanson
Fay Hoch
Mary Inkster
Julie Isleifson
Ina Jablonski
John Jack
Bonny Kahanovitch
Susan Keller
Barbara King
Shirley Kowalchuk
Florence Kristinson
Kristina Kuriata
Emma Lamb
Julie Lamb
Marilyn Lansard
Noel Larocque
Kay LeFevre
Jill Leggatt
Alla Lockhart
Lauren Loewen
Anne McKay
Margaret MacLeod
Peggy Mahon
Marla Mainer
Lorna Marshall
Henrietta Martin
Fran Mason
Edgar Mathias
Bev Mathieson
Esther McCubbin
Marnie McDonald
Megan McEnturff
Kathleen McKay
Mary Louise McKenzie
Violet McKenzie
Alice McLennan
Margaret Mestery
Donna Milionis
Dora Moir
Jennifer Montgomery
Doreen Morris
Jean Morrison
Jeff Mowat
Joey Naslund
Phyllis Nazeravitch
Anne Neal
Netta Nicholson
Darlene Nickel
Diane Norman
Ruth Palachuk
David Parker
Doreen Pauls
Bernice Peichl
Adair Phelps
Jocelyn Pittman
Irmi Plett
Shirley Poole
Tarra Pope
Barbara Prosser
Norah Quinton
Dorothy Rankin
Marjorie Relano
Bonnie Robertson
Joan Robbins
Kay Rokala
Sarah Runions
Inez Salter
Betty Sampson
Helen Scoble
Ann Shade

Lorraine Shields
Racquel Shore
Olive Simpson
Florence Sinclair
Margaret Slater
Dorothy Sly
Mona Sorby
Christine Sorko
Evelyn Stanley
Jean Stewart
Oswald Striker
Margaret Swayze
Bernice Taylor
Esther Taylor
Lorraine Tennant
Blanche Thompson
Ressa Tod
Daisy Tooth
Fannie Unrode
Helen Vidal
Leanne Voakes
Merl Voakes
Trudy Waller
Jennifer Watt
Kimberly Weiderman
Myrtle Weir
Sandra Whitehead
Jasmin Wood
Eileen Wright
Donna Zoochkan

# EPIDEMIOLOGY AND BIOSTATISTICS

**DIRECTOR** — N. W. Choi, M.D., M.P.H., Ph.D., F.A.C.E.

**BIOSTATISTICIANS** — N. A. Nelson, B.A., M.A., Ph.D.;
P. F. Moodie, B.Sc. Hons., M.Sc.

**SECRETARY**

M.-P. Regan

**RESEARCH FELLOW**

A. Ruder, B.A., Ph.D.

**FIELD INVESTIGATORS**

M. Conway, J. Du, J. Stasiuk, C. Sobie, C. Strutt, J. Ediger, HRA

**DATA PROCESSING**

M.-P. Regan

## INTRODUCTION

The discipline of Epidemiology is a branch of medical science which studies distribution, dynamics and determinant of diseases such as cancer, in a community.

The study provides us with clues to etiologies and bases for prevention of such diseases. Epidemiology was instrumental in the control of many infectious diseases over the centuries and has become an important contributor to cancer control programs around the world.

In 1968, the program of Epidemiology and Biostatistics was established in the Manitoba Cancer Treatment and Research Foundation with a view to furthering the establishment of preventive measures against cancer and to facilitating data storage and retrieval systems in the registries of cancer patients and cytology screening for epidemiological, statistical and evaluation studies. The program was one of the first of its kind in Canada and has resulted in significant contributions to the cancer control programs of the Province.

The provincial registries of cancer patients and cytology screenings have been primary sources of epidemiological studies and have been steadily improved over the past two decades. Studies on the interaction of genetics and environmental factors became an added component of our program since 1985 due to the expertise of an added geneticist.

The Epidemiology and Biostatistics program has also been active in undergraduate and graduate teaching programs. The following report outlines the progress of the ongoing projects and briefly describes the nature of the new studies.

## LUNG CANCER AND THE DOMESTIC ENVIRONMENT

*N. W. Choi, N. A. Nelson, P. F. Moodie, J. Du, J. Stasiuk, C. Sobie*

As reported in 1985, our department is working on a case-control study of lung cancer and the domestic environment under the auspices of National Health and Welfare Canada.

In the last few years it has been ascertained that elevated levels of radon and radon daughters are present in many Canadian homes. The elevated levels found in some of these homes may be approaching those in uranium mines and thus could result in a substantial public health hazard. If radiation interacts multiplicatively with cigarette smoking in increasing the risk of lung cancer, this has very substantial implications for exposure in homes. To fully evaluate the effect of radiation in homes in increasing the risk of lung cancer it is necessary to document precisely the cigarette smoking of individuals, their exposure to occupational risk factors, their diet and their family history as well as attempting to document as precisely as possible their radiation exposure.

So far we have completed interviews of some 400 pairs of cases and controls including grab sampling of radiation and placing of dosimeters in the households of the study subjects.

## CHILDHOOD CANCER AND CONGENITAL ANOMALIES ARE ASSOCIATED IN FAMILIES

*A. M. Ruder, N. W. Choi*

Personal and parental information for 679 children born in Manitoba between 1950 and 1974 and diagnosed with cancer by the age of 14, and for 1457 age-matched Manitoba-born controls, was checked (blind as to case-control status) against the Manitoba Congenital Anomalies Registry for 1964-78. The Congenital Anomalies Registry was begun in 1964, so no self-matches were possible for children born before that year. Missing parental information, more likely for patients than controls, prevented confirmation of many tentative matches. For these reasons, the numbers of matches (1.1% of controls and 2.4% of patients) are likely to be underestimates. The odds radio — of a patient or patient sibling being in the Registry over that of a control or control sibling — was 2.17 (95% confidence limits, 1.08, 4.37). Not only was the odds ratio of a childhood cancer patient himself or herself being in the Registry was 2.15 times that of a control, but the odds ratio of a sibling of a cancer patient being in the registry was 2.16 times that of a sibling of a control. The latter finding, especially, is evidence for familial aggregation of a genetic or developmental event that results in congenital anomaly, or cancer, or both.

Further analyses will be done on the data in 1987.

## LONG-TERM SURVIVAL AMONG BREAST CANCER PATIENTS

*A. M. Ruder, N. A. Nelson, P. F. Moodie, N. W. Choi*

We abstracted survival information on a combined data file of patients who had participated in interview studies and included stage at diagnosis, disease laterality, date of death for the decreased or date of last contact (for the living as well as current status, having developed another primary cancer; for the dead, whether breast cancer metastases, another cancer, another disease or an accident was the cause of death). Details of treatment and date of recurrence were not included because a large number of records did not have this information. Records were available for 152/165 (92%) of 1971-72 patients, 140/145 (97%) of 1973-74 patients, and 264-279 (95%) of 1977-78 patients. Separate analyses were undertaken, within each datafile, for all three sets of interview parameters, to ascertain if any interview parameters were predictors of survivorship. In addition, a combined datafile was created to analyze parameters present in all three datasets, including such variables as age at diagnosis, ethnic origin, birthplace, weight at menopause as well as reproductive history, contraceptive pill use, stage at diagnosis and many more.

In addition to analyzing survival, we assessed quality of survival by comparing women who had disease-free survival with those, living or dead, who had experienced recurrence, metastasis or a second primary, excluding women who had died of causes other than cancer.

Further analyses will be conducted on the family history of cancer.

## DOES FAMILY HISTORY OF BREAST CANCER IMPROVE SURVIVAL AMONG BREAST CANCER PATIENTS?

*A. M. Ruder, P. F. Moodie, N. A. Nelson, N. W. Choi*

Overall cancer mortality to December 1985 among 291 breast cancer patients diagnosed between 1971-1974, and interviewed shortly after diagnosis, was 39.9% (116 deaths). In this study population, a positive maternal family history was strongly associated with breast cancer; the odds ratio for patients vs. controls of having a mother with breast cancer was 3.32 (95% confidence limits 1.64, 6.72), of having a mother, sister, or maternal aunt with breast cancer, 1.92% (95% confidence limits 1.27, 2.91). However, family history was not associated with stage at diagnosis, the most important survival factor (53.6% of patients with family history and 51.7% without were at a local stage at diagnosis). Survival was better, although not significantly better, among women with maternal relatives with breast cancer.

The relative risk of dying with cancer, adjusted for confounding factors, was 1.40 for women without vs with a family history; the difference in survival was not statistically significant for either category.

## SOME ASPECTS OF EPIDEMIOLOGY AND CLINICAL FEATURES OF PRIMARY INTRACRANIAL NEOPLASMS IN MANITOBA

*G. R. Sutherland, R. Florell, A. A. F. Sima, N. W. Choi*

The incidence of primary intracranial tumors in Manitoba, Canada, was reviewed from 1980 through 1985 (population = 1,044,000). During this period, 657 tumors were diagnosed (crude incidence = 10.5/100,000/yr) with the three most common tumors being: astrocytoma 281 (43%), meningioma 145 (22%), and pituitary adenoma 111 (17%). Age specific annual incidence rates for all tumors showed two peaks. The first occurred within the 0-5 age group (3.9/100,000/yr), and the second within the 60-69 age group (26.7/100,000/yr). After the sixth decade, the incidence of neoplasms declined. Among malignant astrocytoma, the age specific annual incidence rate increased to the sixth decade (14.1/100,000/yr), following which, it fell to 4/100,000/yr for the ≥ 80 age group. The incidence of benign astrocytoma remained relatively constant with age (1/100,000/yr). Although meningioma initially increased in incidence with age, it was found to plateau in the fifth decade at 7/100,000/yr. Among the 145 meningioma patients, 56 (39% had meingotheliomatous histology, 48 (33%) transitional, 10 (17%) malignant, 7 (5%) fibroblastic, 6 (4%) psammomatous, 3 (2%) angioblastic, and 15 (10%) unknown. Pituitary adenoma shoed a bi-modal incidence with the first peak occurring in the second decade (2.7/100,000/yr), and a second in the fifth decade (3.1/100,000/yr).

## EPIDEMIOLOGICAL STUDY OF LUNG CANCER AMONG URANIUM MINERS OF ELDORADO RESOURCES LIMITED

*N. W. Choi, J. Du in collaboration with NCIC*

This is a case-control study of Radon Daughter exposure and smoking in relation to lung cancer occurring amongst workers at a uranium mine. The association between exposure to the radioactive daughter products of Radon 222 and increased risk of lung cancer is now well established, and there seems little doubt as to the causality of this relationship. Although smoking is known to account of 80-90 percent of lung cancer in males and a smaller though significant proportion in females, because of the high incidence of the disease, there is still a large absolute number of cases occurring in non-smokers, and it is important to determine what portion of these cases might be accounted for by radon daughter exposure. It is also important to assess the nature of the interaction of radon daughters with smoking to determine what role radon daughters play in the occurrence of lung cancer amongst smokers.

## CASE-CONTROL STUDY OF THYROID CANCER WITH EMPHASIS ON RADIATION AS A RISK FACTOR — Pilot Study

*N. W. Choi, M. Conway in collaboration with the Alberta Cancer Board*

Although it has been established that radiation therapy for benign conditions of the head and neck in infancy and childhood produces thyroid cancer in later life, the proportion of cases in Canada attributable to this cause is not known. Nor do we know how much is due to the radiation associated with the use of radionucluides or with diagnostic x-rays. As the incidence of thyroid cancer is increasing in Canada it is important to know how much of the incidence is attributable to particular types of radiation.

To provide such estimates the Canadian Cancer Registries Epidemiology Research Group (CCRERG) proposed a national population-based case-control study of thyroid cancer. The objectives of the study were:

1. to estimate the relative-risk of thyroid cancer associated with different forms of x-radiation and radionucluides by comparing the history of such exposures in cases of thyroid cancer and controls selected radomly from the population adjusted for other risk factors.
2. to estimate the proportion of the population exposed to these types of radiation and hence to calculate the proportion of thyroid cancer attributable to these exposures.
3. The design and methods of this pilot study are based on the results of a pilot project done in Alberta.

## RISK FACTORS FOR GASTRIC CANCER — A CASE-CONTROL STUDY IN THE REPUBLIC OF KOREA

*N. W. Choi, N. A. Nelson, P. F. Moodie in collaboration with Dr. J. H. Park, Kyungpook National University School of Medicine*

The objective of this study was to measure risk factors for gastric cancer. The study population included all cancer patients of two Korean counties Sungju and Youngchen who were diagnosed in five years and seven months period between January 1, 1979 and July 31, 1984. In 1986 multivariate analyses were initiated to investigate diet, family history, and drinking water quality as risk factors. The finalization of analysis and report are due in 1987.

## EPIDEMIOLOGY STUDY OF DIET AND PANCREATIC CANCER (SEARCH)

*N. W. Choi, N. A. Nelson, P. F. Moodie, M. Conway in collaboration with the International Agency for Research on Cancer, France*

This is a case-control study involving many centres around the world. Pancreatic carcinoma is relatively common in Western countries including Canada. In this definitive study which followed a pilot study, we have introduced a modified diet and lifestyle questionnaire that permits us to interview proxies.

Data from Manitoba have been sent to the International Agency for Research on Cancer to be included with data from other countries for the final analysis. Results of the study should be available by the end of 1987.

## BRAIN TUMOURS AMONG CHILDREN — (SEARCH)

*N. W. Choi, N. A. Nelson, P. F. Moodie, M. Conway in collaboration with the International Agency for Research on Cancer*

The International Agency for Research on Cancer, through the SEARCH program proposes to serve as the organizing centre for a collaborative case-control study of primary neoplasms of the brain and cranial meninges in children. The specific aims of this study are:

1. To evaluate the role of *in utero* and childhood exposure to N-nitroso compounds. Exposure to N-nitroso compounds, their precursors, and modulators of their metabolism will be examined. Principal categories of exposure will include diet, drinking water, drugs, supplementary vitamins, cosmetics, tobacco, alcoholic beverages and parental occupational exposures.

2. To quantify the importance of two known etiologic factors: (a) *in utero* and childhood exposure to ionising radiation, and (b) neurofibromatosis and other genetic syndromes which predispose patients to brain tumour development.

3. To explore the relation to other suggested risk factors. Data collected for this purpose will include pregnancy and delivery history; birth order, birth weight, maternal menstrual and reproductive history (including outcome of previous pregnancies — e.g. abortion, congenital anomalies) history of head trauma; *in utero* and childhood exposure to barbiturates; urban versus rural residence; exposure to sick animals; complete occupational histories of both parents; other exposure of parents and child to pesticides, solvents and other chemicals; and occurrence of specific diseases in subjects and their relatives.

In order to carry out these objectives, Manitoba along with other collaborating centres will undertake population-based case-control studies of childhood brain tumours.

## BRAIN TUMOURS AMONG ADULTS (SEARCH)

*N. W. Choi, N. A. Nelson, M. Conway in collaboration with the International Agency for Research on Cancer, France*

This is another study of the SEARCH group of studies. This is also a case-control study to explore the relation between brain tumour incidence and a variety of other personal characteristics and exogenous exposures, such as: head trauma; birth order; menstrual and reproductive history; barbiturates, hair dyes; urban versus rural residence; exposure to sick animals; toxoplasma antibody titres; blood type; ethnicity; certain industries, occupations and occupational exposures and certain diseases in subjects and their relatives.

### INTERNATIONAL STUDY ON RADIATION EFFECTS ON SECOND PRIMARY CANCERS — PHASE II: CASE-CONTROL STUDY

*N. W. Choi, N. A. Nelson, P. F. Moodie, W. Wingert, M. Regan in collaboration with the International Agency for Research on Cancer, France*

The international Radiation Study on Cervical Cancer was initiated to provide quantitative information on the relationship between exposure to ionizing radiation and subsequent risk of cancer. The present report includes detailed dose response information on over 4,200 women who developed second cancers following treatment for cervical cancer and on 10,200 individually matched controls selected from a population of approximately 150,000 women. The value of investigations of patients who have received therapeutic doses of radiation lies not in the organs treated, which may already be cancerous and for which the doses may well be beyond the range of interest, but in distal sites that receive low or moderate doses that are more representative of possible occupational or medical exposure situations today. Patients with cervical cancer are of particular interest because survival is relatively good, accurate determination of exposures experienced during treatment is possible, chemotherapy is rarely given as primary or adjuvant treatment, and surgically treated patients not given radiotherapy are available for comparison purposes. Further, radiation treatment for cervical cancer was standardized as early as the 1930's, and thus the pattern of radiation risks over relatively long periods of time after exposure could be evaluated.

The final report is due in early 1988.

### THE EFFECTS OF CHEMOTHERAPY ON SITES SUCH AS OVARY, TESTIS, AND HODGKIN'S DISEASE AS IT RELATES TO SECOND PRIMARY CANCER

*N. W. Choi, N. A. Nelson, J. Ediger in collaboration with the International Agency for Research on Cancer, France*

Manitoba along with ten other population-based cancer registries tabulated second cancers among 133,411 patients diagnosed with testicular cancer, ovarian cancer or Hodgkin's disease between 1945 and 1984. Overall, 3,157 second cancers were observed, as compared with 2,420 expected at least one year after the first cancer. Overdiagnosis, misclassification of metastases and confounding by other risk factors were all considered as explanations of observed excesses. Nonetheless, it appeared that there are clear excess risks for cancers other than acute leukaemia which must be ascribed to therapy for the first cancer, especially in view of the possible under-reporting in registry material. Case-control studies are underway to provide information on the role of specific aspects of therapy.

## Biometry Projects

*N. A. Nelson and P. F. Moodie*

Statistical consultations and programming service were provided to the following departments:

- — Cell Biology
- — Gynecological Oncology
- — Medical Oncology
- — Radiation Oncology
- — Surgical Oncology
- — Physics
- — Records and Registry
- — Social and Preventive Medicine, University of Manitoba
- — Community and Northern Medicine, U. of M.
- — Internal Medicine, U. of M.
- — Nursing, U. of M.
- — Radiology, HSC
- — Community Health Services, Government of Manitoba
- — Geography, U. of W.
- — Canadian Cancer Society, Toronto
- — Health Services Promotion Branch, HWC
- — Consultantship in Republic of Korea

In addition, statistical software were developed by us on the Prime minicomputer and IBM-PC-XT microcomputer to supplement those available in the release of Statistical Analysis Package currently implemented on Prime. Our objective is to develop new software and interface it with that existing so that virtually all statistical requests will be able to be accommodated on our in-house computers.

This is especially advantageous for the statistical analyses of Manitoba Cancer Registry data, where confidentiality is of prime concern.

Our current research in biostatistics involves developing procedures that are appropriate for nonnormal distributions, as biomedical data are typically nonnormal. Often, too much emphasis is placed by statisticians on detecting differences between population means, when it is a variation between populations that should be of concern. For example, a treatment protocol may have a beneficial effect on the average but this effect may vary considerably among patients and this variation in patient response should be assessed. We are currently developing new statistical tests for variability. Through computer simulation studies we are investigating the performance of these tests and are finding that they behave well for different types of data other than the classical normal.

### Planned Studies

The biometry section will be involved in a controlled clinical trial to be implemented to compare conventional planning with CT planning in stages $A_2$, $B_1$, and $B_2$, of prostate cancer. The quality of life, morbidity, relapse, distant failure and survival under the two planning regimes will be analyzed. This project involves Radiation Oncology and the Department of Physics. As well, we have been involved in a feasibility study for the Canadian

Cancer Society for a proposed investigation to evaluate on a national basis the nonmedical needs of cancer patients and families.

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Sutherland, G. R., Florell, R., Choi, N. W., Sima, A. A. F. Some aspects of epidemiology and clinical features of primary intracranial neoplasms in Manitoba. Accepted for Publication Cdn Jr. of Neurological Sciences.

## PRESENTATIONS

Choi, N. W. Cancer control in the Republic of Korea. 1986 Annual Meeting of the Korean Society for Preventive Medicine, November 1986.

Nelson, N. A., Moodie, P. F. Robust tests for homoscedasticity of covariance matrices. XIIIth International Biometric Conference, Seattle, 1986.

## ONCOLOGY RECORDS AND REGISTRY

**Director** — H. Schipper, B.A.Sc., M.D., F.R.C.P.(C)
**Assistant Director, Records & Registry** — G. Hanson
**Assistant Director, Information Services** — P. West
**Secretary** — K. Yaremchuk

### CENTRAL CANCER REGISTRY

**Senior** — J. Kostyra
**Health Record Technicians** — C. Karaz, G. Walsh, J. Walker, W. Wingert, D. Timchishen, M. Parisien
**Clerical Staff** — R. Bresch, A. Cookson, M. Cabral, R. Zaroda

### HEALTH RECORD DEPARTMENT

**Supervisor** — C. Tower
**Records Processing Staff** — G. Aquin, K. Whalen, F. Shilshtut
**Pre-Admission Clerk** — C. Johnson
**Interview Clerk** — L. McCombe
**Receptionist** — G. Haufschild
**Courier/Mail Services** — M. Varkerti
**Medical Transcriptionists** — V. Tuckett, D. Meakin, D. Fry, G. Taylor, C. Cataford
**File Control Clerks** — M. Summers, C. Kelly

### INFORMATION SERVICES/OUTREACH COMPUTER SYSTEM

**Programmer/Analysts** — J. Ediger, B. Burgess, R. Simpson
**Computer Operator** — D. Zimmer

### ST. BONIFACE UNIT

**Supervisor** — L. Soshycki (to March 1987)
**Health Record Technician** — S. Booth
**Medical Transcriptionists** — A. Werbicki, C. Einarson
**Records Processing Staff** — K. Friesen, C. MacLean
**File Control Clerk** — J. Redden
**Receptionist** — S. Johnson

### RECORDS & REGISTRY

#### *SCOPE OF SERVICES*

The Records & Registry Department began as a rudimentary tumour service in 1937. Since then, its history has been characterized by change, and the past year was no exception. A major reorganization transformed this computerized, multifunctional department into a configuration which will more effectively fulfill its mandate of health information processing, and meet the challenges of future development. The Department is now structured as follows:

## Central Cancer Registry

The activities of this unit fall into two major areas:

1. The provision of an accurate cancer incidence database for health care planning and quality assurance.

2. The provision of a research database for the detailed study of malignant disease, (including epidemiological studies, health care delivery analyses and natural history studies).

The staffing complement includes a Supervisor, one Quality Control and five Staff Health Record Technicians, and three Clerical Support Staff.

In addition to the legally mandated collection, registration and maintenance of data on all cancer cases in Manitoba, the department is committed to a strong supportive role in assisting researchers. In the past year, the Health Record Technicians have initiated a number of ongoing research studies, based on their unique perspective on the database.

The amalgamation of our Cancer Registry with treatment records for those patients receiving care at the Foundation has produced a comprehensive database. In 1986, we saw a substantial increase in the number of requests for information, from 90 in 1985 to approximately 150. These requests ranged from simple incidence figures to detailed audit of records based on multiple criteria. As has been the trend, the Foundation's Epidemiology and Biostatistics Department has been our prime user, generating approximately 45% of our requests.

Registrations in 1986 totalled approximately 6,200 new cancer primaries, 3,400 of which were new treatment patients at the Manitoba Cancer Foundation.

The Central Cancer Registry continues to be an active contributor to the National Cancer Incidence Reporting System and a participating member in the National Cancer Registries Association.

The Section liases with the province's Health Record Technician course and with peer groups in active health care facilities, providing expertise in oncological coding.

## Health Record Services

The recent amalgamation of the Transcription Services/File Control and Record Processing areas has created this comprehensive health records unit which provides the following services:

- Initial information collection and patient documentation.
- Active patient record maintenance and processing.
- Coordination and documentation of diagnostic reports.
- Medical transcription services.
- Health records access & control.
- Chart material distribution.
- Reception and switchboard services.
- Courier services and mail processing.

The staffing complement includes one Supervisor, two Records Processing Clerks, a Pre-registration/Outreach Clerk, four Medical Transcriptionists, two File Control Clerks, an Interview Clerk, a Courier and a Receptionist.

The realignment of these areas sets the stage for enhancement of services and the broadening of our role in quality assurance activities. In addition to the basic records maintenance and support functions delivered in the past, the unit will expand its scope to provide leadership in areas such as documentation standards and care quality audit.

Our transcription services produce an average of 300 pieces of clinical dictation daily, comprising approximately 3,000 lines.

### St. Boniface Unit

Our satellite health record unit provides services to our St. Boniface Oncology Department in all the functional areas noted above. The staffing complement consists of one Supervisor, three Medical Transcriptionists, a Health Record Technician, a File Control Clerk, one-and-a-half Records Processing Clerks and a Receptionist. The unit looks forward to expansion of its role in pre-registration and quality assurance.

### *YEAR'S ACTIVITIES*

Many of the assessment and review activities conducted during 1985 have now borne results, the most substantive being the reorganization of the department. As well, because many of the initiatives commenced in 1985 are long term, they progressed through 1986. In addition to the day-to-day functions of the department, the following activities received added effort:

1. With the reorganization of the department's functional units came the redefinition of the Senior's roles to more fully reflect their level of responsibility. This has provided added opportunity for the Assistant Director to conduct administrative functions, such as development and updating of Records & Registry's policies and systems.

2. As acquisition of more current transcription technology was deemed a priority for the department, much effort was put into product evaluation and recommendation. A phased approach has been pursued, calling for a new dictation system the first year and the addition of word processing capabilities in the next stage.

3. The thrust for staff education continues. A number of staff members have availed themselves of the opportunity to upgrade their qualifications, and others to maintain their expertise in the field.

4. In 1986, the department took on an expanded role in the initial patient pre-registration process within the Foundation, by reallocating to our staff roles formerly filled on an ad-hoc basis by personnel outside the department. This role will be expanded to include appointment generation and triage of new patients. As this service broadens and stabilizes, provision of similar service will be instituted at our St. Boniface Unit.

5. The department undertook a very strong developmental and supportive role to the Foundation's Outreach Program, providing both administrative and functional expertise in areas such as health information processing and quality assurance. Our Transcription Service and an Outreach Clerk continue to facilitate the communication between the specialist oncologist and the Outreach Centre.

6. Our quality assurance program continues to advance. Quantitative measurement occurs consistently throughout the department's services. Qualitative audits have been developed in a number of areas, and we anticipate that the Quality Assurance Program will move forward substantially as the newly created Supervisors become orientated to their expanded roles.

### *THE FUTURE*

1. Quantitative and qualitative analysis of clinical records will be emphasized and upgraded through development of medical audit and documentation standards systems.

2. Consequent to the reorganization of the department, our Procedure Manual and all job descriptions will be reviewed and revised. Our emphasis on quality control issues will be reflected in these revisions.

3. A formal performance appraisal system will be initiated.

4. Evaluation of retention policies and feasibility assessment of a microfiche program and/or off-site storage are brought into focus by the saturation of existing records storage space. In addition, the longer term nature of cancer treatment will necessitate the expansion of active records storage space, by such means as the acquisition of mobile storage systems.

5. Our computerized data collection system has served us well. To more fully utilize the resource available to us, the following automation enhancements will be pursued:

- The pre-admission process (data collection and form generation).
- A record location/tracking system.
- Health record number generation and control.
- Hard copy registry file generation.
- Communication to Outreach Centres.

6. The next year will see an even greater push towards use of the cancer registry database by external researchers, health policy planning agencies and our own department. Concurrent maturation of our Registry Quality Control Program will ensure that the database retains its value in this regard.

## INFORMATION SERVICES

### *INTRODUCTION*

The major responsibility of Information Services, the computing division of the Records & Registry Department, is support and maintenance of the electronic compliment of our health record holdings. Since 1982, a Prime minicomputer has been the repository of a menu-driven, medical information management system that is comprised of two major components: a Patient Identification database and a Case Registration database.

The Patient Identification database (188,560 records) contains basic demographic data for all patients treated by the Foundation since 1937. Data recorded includes a central registration number (as well as other hospital and provincial medical registration identifiers used for cross-referencing), patient name (maiden name and/or known alias if applicable), address, dates of birth and death, and Foundation physician.

The Case Registration database (132,663 records), which is linked to the Patient Identification database by the central registration number, contains information about each primary neoplasm. This encompasses data with regard to disease site (international disease code, topography, morphology, metastatic sites, staging information when available); diagnostic process (date, method, institution); laboratory results; treatment specifics; and if applicable, information related to the death of the patient (date, cause, autopsy results, death registration number).

Extensive data handling features are resident within the information management system, allowing authorized health care professionals the ability to: access patient information with elaborate alphabetic and numeric inquiry techniques; update the contents of existing patient records; edit audit-identified discrepancies in records; and delete records which have duplicate entries.

The minicomputing resource remains available to Foundation investigators that require dataset storage and processing capabilities that exceed the capacity of microcomputers. Tools that compliment the manipulation and analysis of datasets include sophisticated editing and statistical analysis software.

## ACTIVITIES

### Microcomputing Assistance Program

The Foundation entered 1986 with an inventory of nine microcomputers. To effectively manage the increasing number of requests from various departments for product information and operational assistance Information Services established the Microcomputing Assistance Program. Activities were focused on defining the scope of services offered and developing the necessary policies, procedures and standards.

At the end of 1986, Information Services was coordinating the use of fifteen microcomputers. Similar growth in microcomputer acquisitions is predicted for 1987.

### Outreach and the Computerized Cancer Patient Information System

The Outreach Project, a grant-funded research study initiated in 1978, conservatively demonstrated the safety and efficacy of a regional health care program that involved rural-based general practitioners, working in close communication with Foundation oncologists, in the pre-planned chemotherapy treatment and long-term follow-up of cancer patients originally diagnosed at the Foundation. Coincident with this research was the development of a model for a comprehensive, computerized data handling system. The Foundation's proposal to implement the Outreach Program province-wide was adopted by the Manitoba government in November of 1985. Approval was also obtained to design and develop the Computerized Cancer Patient Information System.

Following the assembly and medical orientation of the software development team, efforts were concentrated on the design of a general treatment plan entry and management system. The design will be prototyped in 1987.

## MINICOMPUTER CONFIGURATION

Hardware: Prime 2550 processor
3 Mb memory
300 Mb removable media disk
160 Mb fixed media disk
800/1600 BPI magnetic tape unit
300 LPM character matrix printer
14 video display terminals

Software: Database management — INFORMATION
SIMPLE
ESCAPE
MIDASPLUS
Programming language — COBOL
FORTRAN
Statistical analysis — SAS

## RECORDS AND REGISTRY ACCESS GUIDELINES

In 1984, the Records and Registry Advisory Committee developed the following policies to regulate the use of the Patient Information and Case Registration databases in research studies.

1. Projects must be approved by the Director, with the advice of the Records & Registry Research Advisory Committee according to the following criteria:
    i. The goals of the Cancer Registry.
    ii. The adequacy of research design.
    iii. Personnel, computer & other demands.
    iv. Current operational demand.
2. Projects may be of three types:
    i. *Operational:* Necessary to the day-to-day function of the Manitoba Cancer Treatment and Research Foundation, eg. site reviews, radiotherapy utilization studies, etc. These may be undertaken only by MCF staff in their fields of expertise.
    ii. *Research:* Open to all qualified researchers. Must be approved by the Ethics Committee, U. of M. Any appropriate utilization of the resource is encouraged. In particular natural history, epidemiology and econometric studies are encouraged. Clinical studies may also be reviewed by the Protocol Review Committee of the Foundation.
    iii. *Computer applications:* The computer resource is available to MCF personnel for analytic, process control and other applications as may be deemed feasible from time to time by the participants.
3. Pilot projects and feasibility studies are encouraged and may be supported by Records & Registry staff as resources permit.
4. All projects must be reviewed by the Records & Registry staff for statistical and computational feasibility *prior* to review by the Director. Applicants should view this process as consultative, intended to minimize effort and maximize utilization of the resource.
5. For all projects, *strict* confidentiality must be assured at all times. All persons accessing the registry will be required to sign an oath of confidentiality.
6. While the primary objective of Records and Registry review is to assure efficient and proper use of the Registry and confidentiality, research proposals which have not been externally funded and/or have not undergone independent peer review, may also be

examined as to scientific merit. Clearly, projects involving extensive staff and resource commitments will be closely reviewed.

7. All projects will be priorized by the Director. The operational requirements of the registry will always take precedence over research activity and may, from time to time, occupy all available resources. Staff will attempt to schedule research projects so as to minimize such inconveniences to the investigators. Priorization guidelines will include:
    1. Size of staff and computer requirements.
    2. Scientific merit as it relates to the goals of the Registry.
    3. Project deadline.
    4. Funding status of the project.
8. Projects of type (ii) & (iii), Item 2, will be charged for resource utilization at rates to be established from time to time. These charges may include:
    - i. Statistical consultation time.
    - ii. Programming & programming assistance.
    - iii. Computer utilization time.
    - iv. Medical records staff time.
    - v. Consumables, telephone charges, etc.
9. The data remain the property of the MCF, and users must acknowledge the Registry in publications and presentations.
10. Researchers who require consultation will be encouraged to use the Manitoba Cancer Foundation resource for data analysis to maximize utlization of the experience and expertise of Manitoba Cancer Foundation staff.
11. MCF Records & Registry will assume no responsibility for the accuracy of data reported by investigators using the Registry, or for any interpretations thereof.
12. Researchers must agree to submit to the Director all papers and reports for publication for review prior to distribution or publication to assure that the anonymity of respondents is preserved and that any reference to the Registry is factually correct.

# GRANTS FOR RESEARCH AWARDED BY THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION FOR 1986-1987

## OPERATING GRANTS

*D. Chow*
Natural Antibody Tumor Targets & Growth Factor Receptors

*W. Huda*
Electron Dosimetry

## EQUIPMENT GRANT

*F. Paraskevas*
Fraction Collector

## POSTDOCTORAL FELLOWSHIPS

*G. McClarty*
*A. Ruder*
*J. K. Batra*

## STUDENTSHIPS

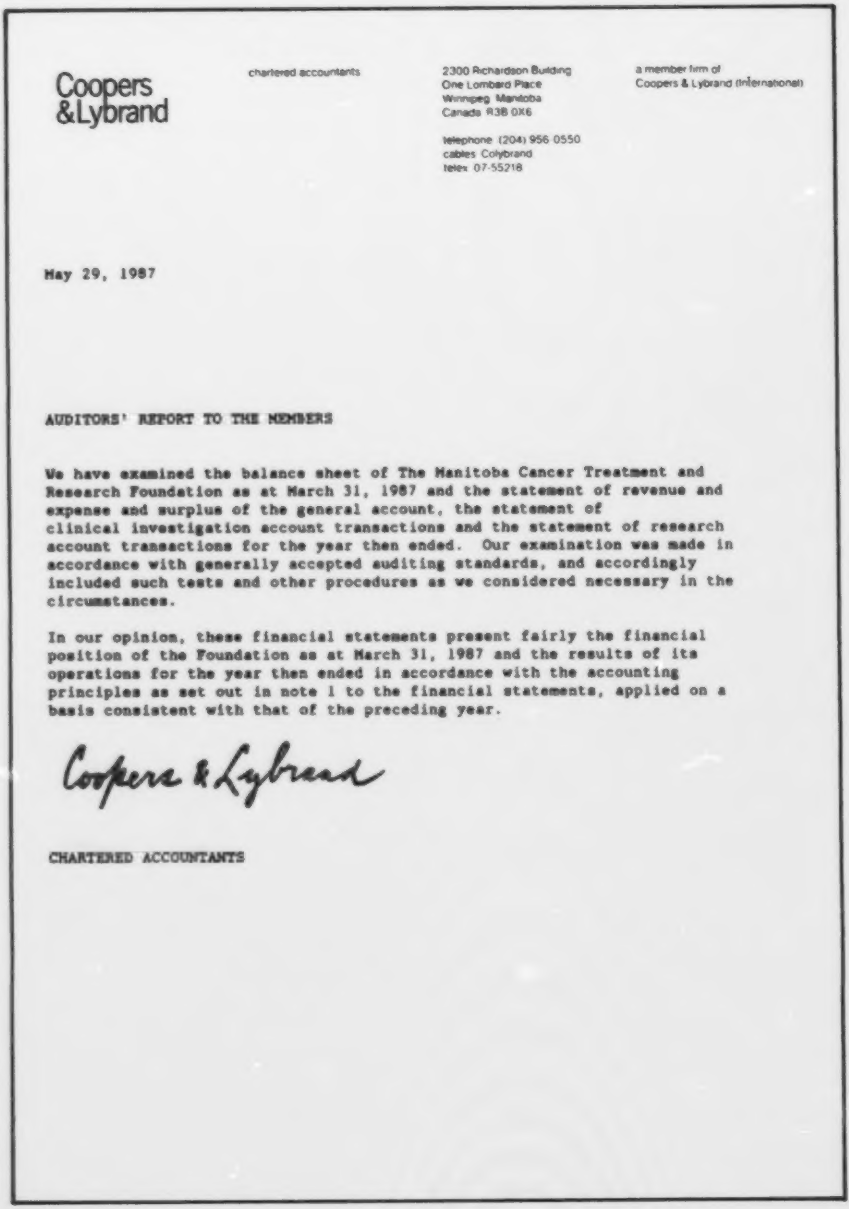
*G. Hicks*
*I. Jesson*
*W. Leszczynski*
*E. Papiez*
*M. Reese*
*A. Tagger*
*B. Therrien*

## ONGOING CAREER AWARDS

*A. Begleiter*
*M. Mowatt*

# AUDITOR'S REPORT TO THE MEMBERS FOR THE YEAR ENDING

## MARCH 31, 1987



Coopers
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a member firm of
Coopers & Lybrand (International)

May 29, 1987

**AUDITORS' REPORT TO THE MEMBERS**

We have examined the balance sheet of The Manitoba Cancer Treatment and Research Foundation as at March 31, 1987 and the statement of revenue and expense and surplus of the general account, the statement of clinical investigation account transactions and the statement of research account transactions for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion, these financial statements present fairly the financial position of the Foundation as at March 31, 1987 and the results of its operations for the year then ended in accordance with the accounting principles as set out in note 1 to the financial statements, applied on a basis consistent with that of the preceding year.

Coopers & Lybrand

CHARTERED ACCOUNTANTS

## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## BALANCE SHEET AS AT MARCH 31, 1987

### ASSETS

| | 1987<br>$ | 1986<br>$ |
|---|---|---|
| | **GENERAL ACCOUNT** | |
| Cash and term deposits | 911,444 | 909,968 |
| Amounts owing by the Manitoba Health Services Commission | 168,975 | 140,040 |
| Amounts owing by the Province of Manitoba | - | 47,500 |
| Accounts receivable | 6,133 | 22,408 |
| Inventory of supplies - at cost | 42,027 | 32,812 |
| Prepaid expenses | 29,620 | 23,980 |
| Equipment - at nominal value (note 1) | 1 | 1 |
| | 1,158,200 | 1,176,709 |
| | **CLINICAL INVESTIGATION ACCOUNT** | |
| Cash and term deposits | 320,187 | 312,605 |
| Accounts receivable | 9,913 | - |
| | 330,100 | 312,605 |
| | **RESEARCH ACCOUNT** | |
| Cash | 44,373 | 189,161 |
| Accounts receivable and accrued interest | 182,750 | 237,491 |
| Investments - Schedule A | 5,768,679 | 4,804,806 |
| | 5,995,802 | 5,231,458 |

SIGNED ON BEHALF OF THE FOUNDATION

Member

Member

## LIABILITIES

| | 1987<br>$ | 1986<br>$ |
|---|---|---|
| Accounts payable and accrued liabilities | 502,696 | 554,773 |
| Term bank loan (note 2) | 19,050 | 47,850 |
| Surplus | 636,454 | 574,086 |
| | 1,158,200 | 1,176,709 |
| Accounts payable | 33,655 | - |
| Commitments payable | 296,445 | 312,605 |
| | 330,100 | 312,605 |
| Accounts and grants payable | 176,755 | 164,540 |
| Research fund | 5,819,047 | 5,066,918 |
| | 5,995,802 | 5,231,458 |

## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## GENERAL ACCOUNT

## STATEMENT OF REVENUE AND EXPENSE AND SURPLUS

## FOR THE YEAR ENDED MARCH 31, 1987

| | 1987<br>$ | 1986<br>$ |
|---|---|---|
| **REVENUE** | | |
| Manitoba Health Services Commission | 7,385,637 | 6,949,902 |
| Province of Manitoba | 167,055 | 190,000 |
| Recoveries from other institutions | 81,094 | 61,965 |
| | 7,633,786 | 7,201,867 |
| **EXPENSE** | | |
| Operating expenses - | | |
| Salaries and benefits | 5,994,220 | 5,427,934 |
| Building occupancy | 626,027 | 591,450 |
| General expenses | 456,633 | 343,864 |
| Supplies and other departmental expenses | 205,164 | 237,816 |
| Diagnostic services | 178,067 | 184,745 |
| | 7,460,111 | 6,785,809 |
| Equipment purchases (note 1) | 264,362 | 440,859 |
| | 7,724,473 | 7,226,668 |
| EXCESS OF EXPENSE OVER REVENUE | (90,687) | (24,801) |
| DEFICIT RECOVERABLE FROM MANITOBA HEALTH SERVICES COMMISSION | 90,687 | 24,801 |
| | - | - |
| OTHER INCOME - net | 62,368 | 70,284 |
| SURPLUS FOR THE YEAR | 62,368 | 70,284 |
| SURPLUS - BEGINNING OF YEAR | 574,086 | 503,802 |
| SURPLUS - END OF YEAR | 636,454 | 574,086 |

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## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

### STATEMENT OF CLINICAL INVESTIGATION ACCOUNT TRANSACTIONS

### FOR THE YEAR ENDED MARCH 31, 1987

| | 1987<br>$ | 1986<br>$ |
|---|---|---|
| RECEIPTS | | |
| Grants received | 829,700 | 836,415 |
| DISBURSEMENTS | | |
| Breast screening study | 242,650 | 242,581 |
| Staff salaries | 233,676 | 171,104 |
| Breast cancer adjuvant studies | 47,646 | 46,318 |
| Outreach program study | 33,978 | 44,070 |
| Physics research and development | 42,503 | 43,275 |
| Lonidamine - hypernephroma | 34,365 | 41,672 |
| Studies of lung cancer | 34,274 | 30,711 |
| Terry Fox career awards | 67,716 | 27,121 |
| Studies on pancreatic cancer | 15,804 | 18,195 |
| Bone Imaging Radiopharmaceuticals | 10,130 | 10,459 |
| Electron Dosimetry | 14,159 | - |
| Palliative Care Symposiums | 15,516 | - |
| Other studies | 53,443 | 137,682 |
| | 845,860 | 813,188 |
| EXCESS OF RECEIPTS OVER DISBURSEMENTS (DISBURSEMENTS OVER RECEIPTS) | (16,160) | 23,227 |
| COMMITMENTS PAYABLE - BEGINNING OF YEAR | 312,605 | 289,378 |
| COMMITMENTS PAYABLE - END OF YEAR | 296,445 | 312,605 |

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## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## STATEMENT OF RESEARCH ACCOUNT TRANSACTIONS

### FOR THE YEAR ENDED MARCH 31, 1987

| | 1987 | | | 1986 |
|---|---|---|---|---|
| | Unrestricted<br>$ | Restricted<br>$ | Total<br>$ | Total<br>$ |
| **REVENUE** | | | | |
| Donations - Schedule B | 360,789 | 177,679 | 538,468 | 429,660 |
| Investment income | 583,982 | 7,284 | 591,266 | 511,223 |
| | 944,771 | 184,963 | 1,129,734 | 940,883 |
| **EXPENSE** | | | | |
| Volunteer co-ordinator | - | 10,989 | 10,989 | - |
| Cell Biology | 128,517 | - | 128,517 | 109,145 |
| Research grants and personnel awards | 221,125 | 2,971 | 224,096 | 307,420 |
| Miscellaneous | 12,920 | 1,083 | 14,003 | 24,029 |
| | 362,562 | 15,043 | 377,605 | 440,594 |
| **EXCESS OF REVENUE OVER EXPENSE** | 582,209 | 169,920 | 752,129 | 500,289 |
| **FUND BALANCE - BEGINNING OF YEAR** | 4,818,377 | 248,541 | 5,066,918 | 4,566,629 |
| **FUND BALANCE - END OF YEAR** | 5,400,586 | 418,461 | 5,819,047 | 5,066,918 |

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## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## NOTES TO FINANCIAL STATEMENTS

## FOR THE YEAR ENDED MARCH 31, 1987

### 1. SIGNIFICANT ACCOUNTING POLICIES

**General Account**

**Basis of presentation**

The financial statements have been prepared in accordance with generally accepted accounting principles except that annual expenditures for equipment acquisitions are charged directly to operations.

**Revenue**

Revenue received from the Manitoba Health Services Commission for net insured patient costs is based on operating budget amounts approved annually and adjusted for amounts to be returned to or recovered from the commission in respect of surplus or deficit arising in the current fiscal year.

**Surplus and deficit**

The Foundation is entitled to retain surpluses arising from excess of revenue over approved expenses for each fiscal year up to a maximum of 2% of the net insured patient costs. Any surplus amount in excess of the maximum is returned to the Manitoba Health Services Commission.

The Foundation may recover deficits arising from excess of approved expense over revenue by making application to the Manitoba Health Services Commission.

**Clinical Investigation Account**

**Basis of presentation**

The Clinical Investigation Account segregates grants received for specific clinical research projects undertaken by the Foundation. Grants received and disbursements made are recorded on a cash basis. In general, the term of these projects varies from one to three years.

## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## NOTES TO FINANCIAL STATEMENTS

## FOR THE YEAR ENDED MARCH 31, 1987

### 1. SIGNIFICANT ACCOUNTING POLICIES (cont'd)

**Research Account**

Investments

Investments are recorded at cost with any premium or discount being amortized over the term of the investment.

Investment income is recorded on the accrual basis.

Grants

Grants are included in the expenditures of the Research Fund in the year they are approved.

### 2. TERM BANK LOAN

| | 1987<br>$ | 1986<br>$ |
|---|---|---|
| Term bank loan with interest at the bank's prime rate, repayable monthly at $2,400 plus interest, maturing 1987 | 19,050 | 47,850 |

SCHEDULE A

## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## RESEARCH ACCOUNT

## SCHEDULE OF INVESTMENTS AS AT MARCH 31, 1987

| | Book value $ | Market value $ |
|---|---|---|
| **Bonds and debentures -** | | |
| B.C. Telephone Company - | | |
| 9 7/8%, November 1, 2003 | 50,000 | 50,725 |
| Bell Canada - | | |
| 11 5/8%, May 2, 1990 | 255,345 | 271,875 |
| Government of Canada - | | |
| 13%, June 1, 1987 | 100,000 | 100,950 |
| 13%, June 1, 1987 | 100,000 | 100,950 |
| 13%, June 1, 1987 | 100,000 | 100,950 |
| 10 1/2%, March 15, 1988 | 300,000 | 307,800 |
| 10 1/2%, March 15, 1988 | 49,992 | 51,300 |
| 12 1/4%, November 1, 1989 | 100,000 | 109,500 |
| 9 1/4%, May 15, 1997 | 100,000 | 105,600 |
| 9 1/4%, May 15, 1997 | 100,000 | 105,600 |
| Investors Group Debentures - | | |
| 9 7/8%, October 4, 1998 | 50,000 | 51,125 |
| Ontario Hydro Bonds - | | |
| 9 1/2%, February 10, 2000 | 400,000 | 406,000 |
| Province of Ontario - | | |
| 11 1/4%, March 7, 1989 | 74,905 | 79,088 |
| Royal Bank of Canada - | | |
| 10%, December 1, 1994 | 160,000 | 165,120 |
| Montreal Trust (Credit Foncier) - | | |
| 16 3/8%, May 10, 1987 | 15,000 | 15,000 |
| 16%, May 27, 1987 | 20,000 | 20,000 |
| 16%, June 8, 1987 | 15,000 | 15,000 |
| 16%, June 22, 1987 | 15,000 | 15,000 |
| 16%, July 2, 1987 | 15,000 | 15,000 |
| 13 1/8%, September 10, 1987 | 25,000 | 25,000 |
| 13 1/8%, September 7, 1987 | 25,000 | 25,000 |
| 13 1/8%, September 7, 1987 | 25,000 | 25,000 |
| 12 1/2%, October 22, 1987 | 25,000 | 25,000 |
| Carried forward | 2,120,242 | 2,186,583 |

SCHEDULE A
Page 2

## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## RESEARCH ACCOUNT

## SCHEDULE OF INVESTMENTS AS AT MARCH 31, 1987

| | Book value $ | Market value $ |
|---|---|---|
| Brought forward | 2,120,242 | 2,186,583 |
| Bonds and debentures (cont'd) - | | |
| Credit Foncier (cont'd) - | | |
| 12 1/4%, November 8, 1987 | 15,000 | 15,000 |
| 12%, January 7, 1988 | 15,000 | 15,000 |
| 11 3/4%, February 17, 1988 | 24,984 | 25,000 |
| Canada Treasury Bills - | | |
| 6.6%, April 16, 1987 | 516,516 | 516,516 |
| 8.5%, April 24, 1987 | 586,552 | 586,552 |
| 6.95%, May 23, 1987 | 251,528 | 251,528 |
| 8.3%, June 12, 1987 | 204,680 | 204,680 |
| Bankers Acceptance - | | |
| 6 1/2%, June 16, 1987 | 394,177 | 394,177 |
| Federal Business Development Bank - | | |
| 7 1/8%, April 8, 1987 | 150,000 | 150,000 |
| | 4,278,679 | 4,345,036 |
| Deposit receipts and investment certificates - | | |
| Toronto-Dominion - | | |
| 10.45%, March 15, 1989 | 75,000 | 75,000 |
| Bank of Montreal Mortgage Corporation - | | |
| 16%, July 20, 1987 | 330,000 | 330,000 |
| 12 1/4%, August 3, 1988 | 300,000 | 300,000 |
| Royal Bank Mortgage Corporation - | | |
| 9 3/4%, October 1, 1989 | 25,000 | 25,000 |
| 9 3/4%, October 10, 1989 | 175,000 | 175,000 |
| Canada Trust - | | |
| 10 1/8%, December 2, 1989 | 100,000 | 100,000 |
| Montreal Trust - | | |
| 11 1/4%, October 2, 1990 | 20,000 | 20,000 |
| National Trust - | | |
| 10 1/8%, December 4, 1989 | 70,000 | 70,000 |
| Royal Trust - | | |
| 16 7/8%, June 21, 1987 | 225,000 | 225,000 |
| 11 1/8%, December 18, 1988 | 10,000 | 10,000 |
| 10 1/4%, December 19, 1990 | 150,000 | 150,000 |
| 9 5/8%, May 1, 1991 | 10,000 | 10,000 |
| | 1,490,000 | 1,490,000 |
| | 5,768,679 | 5,835,036 |

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SCHEDULE B

## THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION

## RESEARCH ACCOUNT

## SCHEDULE OF DONATIONS

## FOR THE YEAR ENDED MARCH 31, 1987

| | $ |
|---|---|
| UNRESTRICTED DONATIONS | |
| Estate Olive Katherine Anderson | 25,947 |
| Donation G. N. Andison Foundation | 1,258 |
| Estate A. F. Bartle | 5,857 |
| In memory Doris H. Beachell | 1,671 |
| In memory Mr. Ben Billinkoff | 604 |
| In memory Murray Black | 1,310 |
| In memory Mrs. Irene Bolbecker | 561 |
| Estate Donald F. G. Brown | 3,000 |
| Donation Building Products | 500 |
| Donation Ruth Campbell | 500 |
| Donation Carmen High School Reunion | 500 |
| Donation Mrs. Lucy Chomica | 500 |
| Donation Alexander C. Craig | 5,000 |
| In memory Patricia L. Crammond | 570 |
| Donation Hazel Cumpstone | 1,000 |
| In memory Dr. Bernard Derbach | 1,395 |
| Estate K. Edward | 1,311 |
| Donation Miss Elizabeth A. Evans | 500 |
| In memory Mrs. Eleanore Field | 585 |
| Donation Mr. Bill Galke | 500 |
| Donation Miss Elizabeth Grierson | 500 |
| In memory Mrs. Helen Hagglund | 1,734 |
| Estate Ishmael W. N. Hart | 7,000 |
| Estate Gertrude E. Hay | 2,221 |
| Donation Health Sciences Centre Charitable Fund - Employees | 2,650 |
| In memory H. D. Hughes | 1,000 |
| Estate Ada Lane | 41,606 |
| Estate Phyllis M. Larusson | 500 |
| In memory John P. Litton | 715 |
| Donation Winnifred Lucas | 1,000 |
| Estate Dr. Arthur S. Majury | 10,000 |
| In memory Dr. Arthur S. Majury | 2,135 |
| Donation Manitoba Hydro Selkirk Employees Charitable Donation Fund | 2,500 |
| Donation Maria Maximiano | 550 |
| Estate Mary Moroz | 19,200 |
| In memory Mr. Edward Odway | 595 |
| Donation Nick Osesky | 500 |
| Donation Park Pontiac Buick | 1,000 |
| In memory Mr. Robert Paul | 1,640 |
| In memory Mr. James A. Preston | 512 |
| Estate Karl Preugal | 1,094 |
| In memory Mr. David Racciatti | 775 |
| Estate Phyllis A. Rea | 25,000 |
| In memory Linda J. Scarrow | 3,237 |
| In memory Dorothy Schuckett | 500 |
| Carried forward | 181,233 |

SCHEDULE B
Page 2

### THE MANITOBA CANCER TREATMENT AND RESEARCH FOUNDATION
### RESEARCH ACCOUNT
### SCHEDULE OF DONATIONS
### FOR THE YEAR ENDED MARCH 31, 1987

| | $ |
|---|---|
| Brought forward | 181,233 |
| **UNRESTRICTED DONATIONS (cont'd)** | |
| In memory Nancy Schwabe | 1,563 |
| Estate Kathleen Shaw | 616 |
| In memory Mrs. Jean Simkin | 619 |
| Estate Lillian Claire Smith | 47,181 |
| Donation Standard Aero Limited Employees | 1,500 |
| Donation Lorna Stevens | 800 |
| In memory Anne Tate | 2,000 |
| Donation O. Vandewiebe | 800 |
| Estate Cornelis Van Hartenelt | 13,418 |
| In memory Mr. Ralph Watts | 1,523 |
| In memory William Webb | 1,000 |
| In memory Edward A. Welter | 570 |
| Estate Charles Will | 12,774 |
| In memory William Willis | 1,130 |
| Winnipeg Foundation - | |
| In memory of Samuel & Essie Badham | 2,500 |
| George Gordon Fund | 780 |
| Harry Little Family Fund | 1,000 |
| Estate Thomas William & Anna Ronald Lowe Memorial Fund | 2,198 |
| Donation Lewis & Pearl C. Roth | 6,292 |
| Mr. & Mrs. Joseph Secter | 1,771 |
| Donation Samuel & Sally Stern & Son Ronald | 1,103 |
| Frank Topper & Emma Topper Memorial Fund | 2,800 |
| Bequest Joseph P. Wolinsky | 500 |
| In memory Mr. John Wright | 500 |
| Other memorial contributions and donations in amounts of less than $500 | 74,618 |
| | 360,789 |

**RESTRICTED DONATIONS**

| | $ |
|---|---|
| Estate Goldie Billinkoff | 153,000 |
| Donation Canadian Cancer Society | 10,989 |
| In memory Alice Christie | 1,000 |
| Donation Mrs. H. Kane | 500 |
| In memory S. Milmac | 4,374 |
| Gwen & Joseph Secter Fund | 5,000 |
| Donation Mr. B. Simkin | 500 |
| Donation Hon. G. E. Tritschler | 1,000 |
| Other donations in amounts of less than $500 | 1,316 |
| | 177,679 |

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# CANCER INCIDENCE AND MORTALITY IN THE PROVINCE OF MANITOBA DURING THE CALENDAR YEAR 1986

The following self-explanatory tables and figures will illustrate the extent of morbidity of and mortality from cancer. Tables I to V and Figure 1 refer to the former. Tables VI to IX and Figure 2 to the latter. Unless otherwise indicated, rates are based on Statistics Canada population estimates for 1986.

## TABLE I

### INCIDENCE — PLACE OF DIAGNOSIS 1986

| Source | Male | Female | Total |
|---|---|---|---|
| Health Sciences Centre | 457 | 483 | 940 |
| St. Boniface General Hospital | 464 | 485 | 949 |
| Other Hospitals in Greater Winnipeg | 1,104 | 896 | 2,000 |
| Other Hospitals in Manitoba | 751 | 682 | 1,433 |
| Hospitals Outside Manitoba | 51 | 57 | 108 |
| Doctors and Clinics | 332 | 550 | 882 |
| **Total** | **3,159** | **3,153** | **6,312** |

## TABLE II

### INCIDENCE — RESIDENCE OF NEW CANCER PRIMARIES 1986

| Residence | Male | Female | Total |
|---|---|---|---|
| Greater Winnipeg | 1,662 | 1,806 | 3,468 |
| Manitoba — Outside Greater Winnipeg | 1,388 | 1,229 | 2,617 |
| Non-Manitoba Residence | 107 | 113 | 220 |
| Residence Unknown | 2 | 5 | 7 |
| **Total** | **3,159** | **3,153** | **6,312** |

## TABLE II A

### INCIDENCE — RESIDENTIAL DISTRIBUTION OF NEW CANCER PRIMARIES 1986

| Residence | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Division 1 | 57 | 678.1 | 41 | 526.3 | 98 | 605.1 |
| Division 2 | 86 | 447.9 | 75 | 406.2 | 161 | 427.5 |
| Division 3 | 123 | 670.6 | 104 | 562.6 | 227 | 616.4 |
| Division 4 | 40 | 665.0 | 31 | 543.8 | 71 | 606.0 |
| Division 5 | 83 | 966.8 | 92 | 1,091.9 | 175 | 1,028.8 |
| Division 6 | 46 | 848.7 | 37 | 689.0 | 83 | 769.2 |
| Division 7 | 192 | 723.1 | 179 | 642.0 | 371 | 681.6 |
| Division 8 | 45 | 589.7 | 37 | 513.5 | 82 | 552.7 |
| Division 9 | 61 | 520.0 | 64 | 544.2 | 125 | 532.1 |
| Division 10 | 16 | 435.9 | 13 | 389.8 | 29 | 413.9 |
| Greater Winnipeg | 1,669 | 613.8 | 1,812 | 619.3 | 3,481 | 616.6 |
| Division 12 | 41 | 537.7 | 27 | 376.3 | 68 | 459.4 |
| Division 13 | 60 | 381.1 | 65 | 423.4 | 125 | 402.0 |
| Division 14 | 50 | 697.8 | 39 | 594.5 | 89 | 648.4 |
| Division 15 | 135 | 1,074.8 | 87 | 714.5 | 222 | 897.5 |
| Division 16 | 24 | 415.2 | 33 | 594.0 | 57 | 502.8 |
| Division 17 | 114 | 804.2 | 112 | 803.4 | 226 | 803.8 |
| Division 18 | 67 | 597.1 | 55 | 520.8 | 122 | 560.1 |
| Division 19 | 9 | 140.2 | 8 | 136.8 | 17 | 138.6 |
| Division 20 | 49 | 762.0 | 42 | 684.0 | 91 | 723.9 |
| Division 21 | 49 | 384.6 | 46 | 384.1 | 95 | 384.3 |
| Division 22 | 20 | 143.8 | 24 | 187.9 | 44 | 164.9 |
| Division 23 | 14 | 263.6 | 12 | 255.5 | 26 | 259.8 |
| **Total** | **3,050** | **602.1** | **3,035** | **583.9** | **6,085** | **592.9** |

Based on Statistics Canada 1981 Census Data

## TABLE III

### INCIDENCE — AGE AND SEX DISTRIBUTION OF NEW CANCER PRIMARIES 1986

| Age Group | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| 0-4 | 11 | 26.0 | 9 | 22.5 | 20 | 24.3 |
| 5-9 | 4 | 10.0 | 2 | 5.3 | 6 | 7.7 |
| 10-14 | 4 | 9.7 | 6 | 15.5 | 10 | 12.5 |
| 15-19 | 8 | 18.8 | 13 | 31.8 | 21 | 25.2 |
| 20-24 | 19 | 38.0 | 76 | 157.0 | 95 | 96.5 |
| 25-29 | 20 | 41.2 | 120 | 250.5 | 140 | 145.2 |
| 30-34 | 24 | 54.7 | 126 | 287.0 | 150 | 171.0 |
| 35-39 | 43 | 108.5 | 139 | 349.2 | 182 | 229.2 |
| 40-44 | 78 | 254.9 | 119 | 390.1 | 197 | 322.4 |
| 45-49 | 99 | 391.3 | 159 | 633.4 | 258 | 511.9 |
| 50-54 | 145 | 601.6 | 169 | 698.3 | 314 | 650.1 |
| 55-59 | 232 | 974.7 | 235 | 936.2 | 467 | 955.0 |
| 60-64 | 356 | 1,547.8 | 336 | 1,263.1 | 692 | 1,395.1 |
| 65-69 | 451 | 2,301.0 | 324 | 1,408.6 | 775 | 1,819.2 |
| 70-74 | 553 | 3,331.3 | 424 | 2,058.2 | 977 | 2,626.3 |
| 75-79 | 484 | 4,360.3 | 304 | 2,013.2 | 788 | 3,007.6 |
| 80-84 | 322 | 4,805.9 | 240 | 2,330.0 | 562 | 3,305.8 |
| 85-89 | 129 | 4,777.7 | 138 | 2,464.2 | 267 | 3,216.8 |
| 90 and over | 65 | 5,000.0 | 91 | 2,843.7 | 156 | 3,466.6 |
| Unknown | 3 | 0.0 | 5 | 0.0 | 8 | 0.0 |
| **Total** | **3,050** | **573.2** | **3,035** | **555.3** | **6,085** | **564.1** |

## TABLE IV A

### INCIDENCE
### AGE AND SEX DISTRIBUTION — BUCCAL CAVITY AND PHARYNX 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 1 | 0.3 | 0 | 0.0 | 1 | 0.1 |
| 30-39 | 2 | 2.3 | 0 | 0.0 | 2 | 1.1 |
| 40-49 | 7 | 12.5 | 3 | 5.3 | 10 | 8.9 |
| 50-59 | 19 | 39.7 | 10 | 20.3 | 29 | 29.8 |
| 60-69 | 32 | 75.1 | 5 | 10.0 | 37 | 40.1 |
| 70-79 | 32 | 115.5 | 15 | 42.6 | 47 | 74.1 |
| 80-89 | 12 | 127.6 | 5 | 31.5 | 17 | 67.2 |
| 90 and over | 2 | 153.8 | 1 | 31.2 | 3 | 66.6 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **107** | **20.1** | **39** | **7.1** | **146** | **13.6** |
| **(ii) Lip** | | | | | | |
| Under 30 | 1 | 0.3 | 0 | 0.0 | 1 | 0.1 |
| 30-39 | 1 | 1.1 | 0 | 0.0 | 1 | 0.5 |
| 40-49 | 3 | 5.3 | 0 | 0.0 | 3 | 2.6 |
| 50-59 | 7 | 14.6 | 1 | 2.0 | 8 | 8.2 |
| 60-69 | 8 | 18.7 | 1 | 2.0 | 9 | 9.7 |
| 70-79 | 20 | 72.2 | 6 | 16.8 | 26 | 41.0 |
| 80-89 | 12 | 127.6 | 5 | 31.5 | 17 | 67.2 |
| 90 and over | 2 | 153.8 | 0 | 0.0 | 2 | 44.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **54** | **10.2** | **13** | **2.4** | **67** | **6.7** |

## TABLE IV B

### INCIDENCE
### AGE AND SEX DISTRIBUTION — DIGESTIVE SYSTEM 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 0 | 0.0 | 3 | 1.1 | 3 | 0.5 |
| 30-39 | 7 | 8.3 | 9 | 10.7 | 16 | 9.5 |
| 40-49 | 37 | 66.1 | 21 | 37.7 | 58 | 52.0 |
| 50-59 | 83 | 173.2 | 55 | 111.5 | 138 | 141.9 |
| 60-69 | 149 | 349.7 | 119 | 239.9 | 268 | 290.6 |
| 70-79 | 219 | 790.6 | 157 | 439.7 | 376 | 593.0 |
| 80-89 | 82 | 872.3 | 94 | 591.1 | 176 | 695.6 |
| 90 and over | 12 | 923.0 | 16 | 500.0 | 28 | 622.2 |
| Age not stated | 2 | 0.0 | 0 | 0.0 | 2 | 0.0 |
| **Total** | **591** | **111.0** | **474** | **86.7** | **1,065** | **98.7** |

## TABLE IV B (CONT'D)

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(ii) Oesophagus** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 3 | 5.3 | 1 | 1.7 | 4 | 3.5 |
| 50-59 | 6 | 12.5 | 1 | 2.0 | 7 | 7.2 |
| 60-69 | 9 | 21.1 | 3 | 6.0 | 12 | 13.0 |
| 70-79 | 7 | 25.2 | 5 | 14.0 | 12 | 18.9 |
| 80-89 | 1 | 10.6 | 7 | 44.0 | 8 | 31.6 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 26 | 4.8 | 17 | 3.1 | 43 | 3.9 |
| **(iii) Stomach** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 2 | 2.3 | 5 | 5.9 | 7 | 4.1 |
| 40-49 | 2 | 3.5 | 3 | 5.3 | 5 | 4.4 |
| 50-59 | 10 | 20.8 | 5 | 10.1 | 15 | 15.4 |
| 60-69 | 22 | 51.6 | 15 | 30.2 | 37 | 40.1 |
| 70-79 | 38 | 137.1 | 11 | 30.8 | 49 | 77.2 |
| 80-89 | 16 | 170.2 | 15 | 94.3 | 31 | 122.5 |
| 90 and over | 3 | 230.7 | 2 | 62.5 | 5 | 111.1 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 93 | 17.4 | 56 | 10.2 | 149 | 13.8 |
| **(iv) Large Intestine** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | 1 | 0.1 |
| 30-39 | 3 | 3.5 | 3 | 3.5 | 6 | 3.5 |
| 40-49 | 14 | 25.0 | 7 | 12.5 | 21 | 18.8 |
| 50-59 | 34 | 70.9 | 29 | 58.8 | 63 | 64.8 |
| 60-69 | 60 | 140.8 | 49 | 98.7 | 109 | 118.2 |
| 70-79 | 80 | 288.8 | 82 | 229.6 | 162 | 255.5 |
| 80-89 | 28 | 297.8 | 37 | 232.7 | 65 | 256.9 |
| 90 and over | 4 | 307.6 | 8 | 250.0 | 12 | 266.6 |
| Age not stated | 2 | 0.0 | 0 | 0.0 | 2 | 0.0 |
| **Total** | 225 | 42.2 | 216 | 39.5 | 441 | 40.8 |

## TABLE IV B (CONT'D)

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(v) Rectum and Rectosigmoid Junction** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 12 | 21.4 | 2 | 3.5 | 14 | 12.5 |
| 50-59 | 16 | 33.4 | 11 | 22.3 | 27 | 27.7 |
| 60-69 | 34 | 79.8 | 29 | 58.4 | 63 | 68.3 |
| 70-79 | 51 | 184.1 | 23 | 64.4 | 74 | 116.7 |
| 80-89 | 18 | 191.4 | 16 | 100.6 | 34 | 134.3 |
| 90 and over | 4 | 307.6 | 1 | 31.2 | 5 | 111.1 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 135 | 25.3 | 82 | 15.0 | 217 | 20.1 |
| **(vi) Liver and Biliary Passages** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 1 | 1.7 | 2 | 3.5 | 3 | 2.6 |
| 50-59 | 8 | 16.7 | 4 | 8.1 | 12 | 12.3 |
| 60-69 | 9 | 21.1 | 12 | 24.1 | 21 | 22.7 |
| 70-79 | 11 | 39.7 | 8 | 22.4 | 19 | 29.9 |
| 80-89 | 8 | 85.1 | 10 | 62.8 | 18 | 71.1 |
| 90 and over | 0 | 0.0 | 2 | 62.5 | 2 | 44.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 37 | 6.9 | 38 | 6.9 | 75 | 6.9 |
| **(vii) Pancreas** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 1 | 1.1 | 0 | 0.0 | 1 | 0.5 |
| 40-49 | 3 | 5.3 | 4 | 7.1 | 7 | 6.2 |
| 50-59 | 7 | 14.6 | 5 | 10.1 | 12 | 12.3 |
| 60-69 | 15 | 35.2 | 10 | 20.1 | 25 | 27.1 |
| 70-79 | 20 | 72.2 | 22 | 61.6 | 42 | 66.2 |
| 80-89 | 10 | 106.3 | 8 | 50.3 | 18 | 71.1 |
| 90 and over | 1 | 76.9 | 3 | 93.7 | 4 | 88.8 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 57 | 10.7 | 52 | 9.5 | 109 | 10.1 |

## TABLE IV C

## INCIDENCE — AGE AND SEX DISTRIBUTION — RESPIRATORY SYSTEM 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 5 | 5.9 | 5 | 2.9 |
| 40-49 | 25 | 44.7 | 17 | 30.5 | 42 | 37.6 |
| 50-59 | 69 | 144.0 | 41 | 83.1 | 110 | 113.1 |
| 60-69 | 175 | 410.8 | 73 | 147.1 | 248 | 268.9 |
| 70-79 | 163 | 588.5 | 68 | 190.4 | 231 | 364.4 |
| 80-89 | 54 | 574.4 | 18 | 113.2 | 72 | 284.5 |
| 90 and over | 8 | 615.3 | 4 | 125.0 | 12 | 266.6 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **494** | **92.8** | **226** | **41.3** | **720** | **66.8** |
| **(ii) Larynx** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 4 | 7.1 | 1 | 1.7 | 5 | 4.4 |
| 50-59 | 6 | 12.5 | 2 | 4.0 | 8 | 8.2 |
| 60-69 | 17 | 39.9 | 1 | 2.0 | 18 | 19.5 |
| 70-79 | 9 | 32.4 | 0 | 0.0 | 9 | 14.1 |
| 80-89 | 4 | 42.5 | 1 | 6.2 | 5 | 19.7 |
| 90 and over | 0 | 0.0 | 1 | 31.2 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **40** | **7.5** | **6** | **1.0** | **46** | **4.2** |
| **(iii) Trachea, Bronchus, and Lung** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 4 | 4.7 | 4 | 2.3 |
| 40-49 | 19 | 33.9 | 16 | 28.7 | 35 | 31.3 |
| 50-59 | 61 | 127.3 | 39 | 79.1 | 100 | 102.8 |
| 60-69 | 157 | 368.5 | 71 | 143.1 | 228 | 247.2 |
| 70-79 | 153 | 552.3 | 67 | 187.6 | 220 | 347.0 |
| 80-89 | 50 | 531.9 | 16 | 100.6 | 66 | 260.8 |
| 90 and over | 8 | 615.3 | 3 | 93.7 | 11 | 244.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **448** | **84.1** | **216** | **39.5** | **664** | **61.5** |

## TABLE IV D

### INCIDENCE — AGE AND SEX DISTRIBUTION — BREAST 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Under 30 | 0 | 0.0 | 6 | 2.3 | 6 | 1.1 |
| 30-39 | 0 | 0.0 | 35 | 41.8 | 35 | 20.9 |
| 40-49 | 1 | 1.7 | 92 | 165.4 | 93 | 83.4 |
| 50-59 | 0 | 0.0 | 96 | 194.7 | 96 | 98.7 |
| 60-69 | 2 | 4.6 | 138 | 278.2 | 140 | 151.8 |
| 70-79 | 3 | 10.8 | 142 | 397.7 | 145 | 228.7 |
| 80-89 | 0 | 0.0 | 55 | 345.9 | 55 | 217.3 |
| 90 and over | 0 | 0.0 | 11 | 343.7 | 11 | 244.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **6** | **1.1** | **575** | **105.2** | **581** | **53.8** |

## TABLE IV E

### INCIDENCE — AGE DISTRIBUTION — FEMALE GENITAL ORGANS 1986

| | Female | Rate | | Female | Rate |
|---|---|---|---|---|---|
| **(i) All organs** | | | **(ii) Cervix Uteri** | | |
| Under 30 | 168 | 66.2 | Under 30 | 162 | 63.9 |
| 30-39 | 162 | 193.5 | 30-39 | 150 | 179.2 |
| 40-49 | 74 | 133.0 | 40-49 | 59 | 106.1 |
| 50-59 | 64 | 129.8 | 50-59 | 20 | 40.5 |
| 60-69 | 99 | 199.5 | 60-69 | 26 | 52.4 |
| 70-79 | 58 | 162.4 | 70-79 | 11 | 30.8 |
| 80-89 | 27 | 169.8 | 80-89 | 5 | 31.4 |
| 90 and over | 3 | 93.7 | 90 and over | 1 | 31.2 |
| Age not stated | 1 | 0.0 | Age not stated | 1 | 0.0 |
| **Total** | **656** | **120.0** | **Total** | **435** | **79.5** |

| | Female | Rate | | Female | Rate |
|---|---|---|---|---|---|
| **(iii) Uterus-Corpus etc. (Except Cervix)** | | | **(iv) Ovaries, Fallopian Tubes, Broad Ligaments and other Genital Organs** | | |
| Under 30 | 0 | 0.0 | Under 30 | 5 | 1.9 |
| 30-39 | 3 | 3.5 | 30-39 | 9 | 10.7 |
| 40-49 | 7 | 12.5 | 40-49 | 8 | 14.3 |
| 50-59 | 23 | 46.6 | 50-59 | 21 | 42.5 |
| 60-69 | 49 | 98.7 | 60-69 | 24 | 48.3 |
| 70-79 | 31 | 86.8 | 70-79 | 16 | 44.8 |
| 80-89 | 13 | 81.7 | 80-89 | 9 | 56.6 |
| 90 and over | 2 | 62.5 | 90 and over | 0 | 0.0 |
| Age not stated | 0 | 0.0 | Age not stated | 0 | 0.0 |
| **Total** | **128** | **23.4** | **Total** | **92** | **16.8** |

## TABLE IV F

## INCIDENCE — AGE DISTRIBUTION — MALE GENITAL ORGANS 1986

| | Male | Rate | | Male | Rate |
|---|---|---|---|---|---|
| **(i) All Organs** | | | **(ii) Prostate** | | |
| Under 30 | 10 | 3.7 | Under 30 | 0 | 0.0 |
| 30-39 | 10 | 11.9 | 30-39 | 0 | 0.0 |
| 40-49 | 5 | 8.9 | 40-49 | 1 | 1.7 |
| 50-59 | 19 | 39.6 | 50-59 | 19 | 39.6 |
| 60-69 | 123 | 288.7 | 60-69 | 121 | 284.0 |
| 70-79 | 222 | 801.4 | 70-79 | 222 | 801.4 |
| 80-89 | 103 | 1,095.7 | 80-89 | 102 | 1,085.1 |
| 90 and over | 16 | 1,230.7 | 90 and over | 16 | 1,230.7 |
| Age not stated | 0 | 0.0 | Age not stated | 0 | 0.0 |
| **Total** | **508** | **95.4** | **Total** | **481** | **90.3** |

| | Male | Rate |
|---|---|---|
| **(iii) Other Male Genital Organs** | | |
| Under 30 | 10 | 3.7 |
| 30-39 | 10 | 11.9 |
| 40-49 | 4 | 7.1 |
| 50-59 | 0 | 0.0 |
| 60-69 | 2 | 4.6 |
| 70-79 | 0 | 0.0 |
| 80-89 | 1 | 10.6 |
| 90 and over | 0 | 0.0 |
| Age not stated | 0 | 0.0 |
| **Total** | **27** | **5.0** |

## TABLE IV G

## INCIDENCE — AGE AND SEX DISTRIBUTION — URINARY ORGANS 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 2 | 0.7 | 4 | 1.5 | 6 | 1.1 |
| 30-39 | 2 | 2.3 | 2 | 2.3 | 4 | 2.3 |
| 40-49 | 9 | 16.1 | 2 | 3.5 | 11 | 9.8 |
| 50-59 | 34 | 70.9 | 19 | 38.5 | 53 | 54.5 |
| 60-69 | 44 | 103.2 | 17 | 34.2 | 61 | 66.1 |
| 70-79 | 73 | 263.5 | 24 | 67.2 | 97 | 152.9 |
| 80-89 | 33 | 351.0 | 13 | 81.7 | 46 | 181.8 |
| 90 and over | 2 | 153.8 | 3 | 93.7 | 5 | 111.1 |
| Age not stated | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| **Total** | **200** | **37.5** | **84** | **15.3** | **284** | **26.3** |
| **(ii) Bladder** | | | | | | |
| Under 30 | 1 | 0.3 | 1 | 0.3 | 2 | 0.3 |
| 30-39 | 2 | 2.3 | 0 | 0.0 | 2 | 1.1 |
| 40-49 | 6 | 10.7 | 2 | 3.5 | 8 | 7.1 |
| 50-59 | 24 | 50.1 | 13 | 26.3 | 37 | 38.0 |
| 60-69 | 31 | 72.7 | 11 | 22.1 | 42 | 45.5 |
| 70-79 | 55 | 198.5 | 11 | 30.8 | 66 | 104.1 |
| 80-89 | 29 | 308.5 | 9 | 56.6 | 38 | 150.1 |
| 90 and over | 2 | 153.8 | 1 | 31.2 | 3 | 66.6 |
| Age not stated | 1 | 0.0 | 0 | 0.0 | 1 | 0.0 |
| **Total** | **151** | **28.3** | **48** | **8.7** | **199** | **18.4** |
| **(iii) Kidney** | | | | | | |
| Under 30 | 1 | 0.3 | 3 | 1.1 | 4 | 0.7 |
| 30-39 | 0 | 0.0 | 2 | 2.3 | 2 | 1.1 |
| 40-49 | 3 | 5.3 | 0 | 0.0 | 3 | 2.6 |
| 50-59 | 9 | 18.7 | 6 | 12.1 | 15 | 15.4 |
| 60-69 | 10 | 23.4 | 5 | 10.0 | 15 | 16.2 |
| 70-79 | 15 | 54.1 | 10 | 28.0 | 25 | 39.4 |
| 80-89 | 3 | 31.9 | 3 | 18.8 | 6 | 23.7 |
| 90 and over | 0 | 0.0 | 2 | 62.5 | 2 | 44.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **41** | **7.7** | **31** | **5.6** | **72** | **6.6** |

# TABLE IV H

## INCIDENCE — AGE AND SEX DISTRIBUTION — SKIN 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total Skin** | | | | | | |
| Under 30 | 10 | 3.7 | 14 | 5.5 | **24** | **4.6** |
| 30-39 | 27 | 32.3 | 30 | 35.8 | **57** | **34.1** |
| 40-49 | 62 | 110.9 | 49 | 88.1 | **111** | **99.5** |
| 50-59 | 108 | 225.4 | 79 | 160.2 | **187** | **192.3** |
| 60-69 | 193 | 453.0 | 143 | 288.3 | **336** | **364.4** |
| 70-79 | 250 | 902.5 | 175 | 490.1 | **425** | **670.3** |
| 80-89 | 125 | 1,329.7 | 127 | 798.7 | **252** | **996.0** |
| 90 and over | 15 | 1,153.8 | 37 | 1,156.2 | **52** | **1,155.5** |
| Age not stated | 0 | 0.0 | 4 | 0.0 | **4** | **0.0** |
| **Total** | **790** | **148.4** | **658** | **120.4** | **1,448** | **134.2** |
| **(ii) Melanoma** | | | | | | |
| Under 30 | 1 | 0.3 | 7 | 2.7 | **8** | **1.5** |
| 30-39 | 6 | 7.1 | 3 | 3.5 | **9** | **5.3** |
| 40-49 | 1 | 1.7 | 7 | 12.5 | **8** | **7.1** |
| 50-59 | 2 | 4.1 | 7 | 14.1 | **9** | **9.2** |
| 60-69 | 0 | 0.0 | 10 | 20.1 | **10** | **10.8** |
| 70-79 | 2 | 7.2 | 3 | 8.4 | **5** | **7.8** |
| 80-89 | 3 | 31.9 | 4 | 25.1 | **7** | **27.6** |
| 90 and over | 1 | 76.9 | 0 | 0.0 | **1** | **22.2** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **16** | **3.0** | **41** | **7.5** | **57** | **5.2** |
| **(iii) Other Malignant Neoplasms** | | | | | | |
| Under 30 | 9 | 3.4 | 7 | 2.7 | **16** | **3.0** |
| 30-39 | 21 | 25.1 | 27 | 32.2 | **48** | **28.7** |
| 40-49 | 61 | 109.1 | 42 | 75.5 | **103** | **92.3** |
| 50-59 | 106 | 221.2 | 72 | 146.0 | **178** | **183.1** |
| 60-69 | 193 | 453.0 | 133 | 268.1 | **326** | **353.5** |
| 70-79 | 248 | 895.3 | 172 | 481.7 | **420** | **662.4** |
| 80-89 | 122 | 1,297.8 | 123 | 773.5 | **245** | **968.3** |
| 90 and over | 14 | 1,076.9 | 37 | 1,156.2 | **51** | **1,133.3** |
| Age not stated | 0 | 0.0 | 4 | 0.0 | **4** | **0.0** |
| **Total** | **774** | **145.4** | **617** | **112.9** | **1,391** | **128.9** |

## TABLE IV I

### INCIDENCE — AGE AND SEX DISTRIBUTION
### BRAIN AND NERVOUS SYSTEM (INCLUDING EYE) 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 6 | 2.2 | 4 | 1.5 | **10** | **1.9** |
| 30-39 | 4 | 4.7 | 4 | 4.7 | **8** | **4.7** |
| 40-49 | 5 | 8.9 | 3 | 5.3 | **8** | **7.1** |
| 50-59 | 4 | 8.3 | 5 | 10.1 | **9** | **9.2** |
| 60-69 | 10 | 23.4 | 4 | 8.0 | **14** | **15.1** |
| 70-79 | 6 | 21.6 | 10 | 28.0 | **16** | **25.2** |
| 80-89 | 1 | 10.6 | 0 | 0.0 | **1** | **3.9** |
| 90 and over | 0 | 0.0 | 1 | 31.2 | **1** | **22.2** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **36** | **6.7** | **31** | **5.6** | **67** | **6.2** |
| **(ii) Brain** | | | | | | |
| Under 30 | 3 | 1.1 | 3 | 1.1 | **6** | **1.1** |
| 30-39 | 1 | 1.1 | 4 | 4.7 | **5** | **2.9** |
| 40-49 | 5 | 8.9 | 3 | 5.3 | **8** | **7.1** |
| 50-59 | 2 | 4.1 | 4 | 8.1 | **6** | **6.1** |
| 60-69 | 10 | 23.4 | 4 | 8.0 | **14** | **15.1** |
| 70-79 | 5 | 18.0 | 9 | 25.2 | **14** | **22.0** |
| 80-89 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 90 and over | 0 | 0.0 | 1 | 31.2 | **1** | **22.2** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **26** | **4.8** | **28** | **5.1** | **54** | **5.0** |
| **(iii) Other Parts of Nervous System** | | | | | | |
| Under 30 | 3 | 1.1 | 0 | 0.0 | **3** | **0.5** |
| 30-39 | 3 | 3.5 | 0 | 0.0 | **3** | **1.7** |
| 40-49 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 50-59 | 1 | 2.0 | 0 | 0.0 | **1** | **1.0** |
| 60-69 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 70-79 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 80-89 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 90 and over | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **7** | **1.3** | **0** | **0.0** | **7** | **0.6** |

## TABLE IV J

### INCIDENCE
### AGE AND SEX DISTRIBUTION — THYROID AND ENDOCRINE GLANDS 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 5 | 1.8 | 5 | 1.9 | 10 | 1.9 |
| 30-39 | 4 | 4.7 | 5 | 5.9 | 9 | 5.3 |
| 40-49 | 3 | 5.3 | 7 | 12.5 | 10 | 8.9 |
| 50-59 | 1 | 2.0 | 5 | 10.1 | 6 | 6.1 |
| 60-69 | 6 | 14.0 | 4 | 8.0 | 10 | 10.8 |
| 70-79 | 1 | 3.6 | 1 | 2.8 | 2 | 3.1 |
| 80-89 | 0 | 0.0 | 2 | 12.5 | 2 | 7.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **20** | **3.7** | **29** | **5.3** | **49** | **4.5** |
| **(ii) Thyroid Glands** | | | | | | |
| Under 30 | 4 | 1.5 | 5 | 1.9 | 9 | 1.7 |
| 30-39 | 4 | 4.7 | 5 | 5.9 | 9 | 5.3 |
| 40-49 | 3 | 5.3 | 7 | 12.5 | 10 | 8.9 |
| 50-59 | 1 | 2.0 | 5 | 10.1 | 6 | 6.1 |
| 60-69 | 4 | 9.3 | 4 | 8.0 | 8 | 8.6 |
| 70-79 | 0 | 0.0 | 1 | 2.8 | 1 | 1.5 |
| 80-89 | 0 | 0.0 | 2 | 12.5 | 2 | 7.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **16** | **3.0** | **29** | **5.3** | **45** | **4.1** |

## TABLE IV K

### INCIDENCE — AGE AND SEX DISTRIBUTION — BONES 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Under 30 | 2 | 0.7 | 3 | 1.1 | 5 | 0.9 |
| 30-39 | 0 | 0.0 | 1 | 1.1 | 1 | 0.5 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 0 | 0.0 | 1 | 2.0 | 1 | 1.0 |
| 60-69 | 1 | 2.3 | 1 | 2.0 | 2 | 2.1 |
| 70-79 | 1 | 3.6 | 1 | 2.8 | 2 | 3.1 |
| 80-89 | 2 | 21.2 | 0 | 0.0 | 2 | 7.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **6** | **1.1** | **7** | **1.2** | **13** | **1.2** |

## TABLE IV L

### INCIDENCE — AGE AND SEX DISTRIBUTION — CONNECTIVE TISSUE 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Under 30 | 1 | 0.3 | 2 | 0.7 | 3 | 0.5 |
| 30-39 | 1 | 1.1 | 0 | 0.0 | 1 | 0.5 |
| 40-49 | 1 | 1.7 | 0 | 0.0 | 1 | 0.8 |
| 50-59 | 1 | 2.0 | 1 | 2.0 | 2 | 2.0 |
| 60-69 | 4 | 9.3 | 2 | 4.0 | 6 | 6.5 |
| 70-79 | 3 | 10.8 | 4 | 11.2 | 7 | 11.0 |
| 80-89 | 0 | 0.0 | 1 | 6.2 | 1 | 3.9 |
| 90 and over | 2 | 153.8 | 2 | 62.5 | 4 | 88.8 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **13** | **2.4** | **12** | **2.1** | **25** | **2.3** |

## TABLE IV M

### INCIDENCE — AGE AND SEX DISTRIBUTION
### LYMPHATIC SYSTEM AND HAEMATOPOIETIC TISSUE 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 28 | 10.6 | 17 | 6.7 | 45 | 8.6 |
| 30-39 | 9 | 10.7 | 10 | 11.9 | 19 | 11.3 |
| 40-49 | 14 | 25.0 | 4 | 7.1 | 18 | 16.1 |
| 50-59 | 21 | 43.8 | 15 | 30.4 | 36 | 37.0 |
| 60-69 | 44 | 103.2 | 34 | 68.5 | 78 | 84.5 |
| 70-79 | 39 | 140.7 | 41 | 114.8 | 80 | 126.1 |
| 80-89 | 24 | 255.3 | 19 | 119.4 | 43 | 169.9 |
| 90 and over | 8 | 615.3 | 10 | 312.5 | 18 | 400.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **187** | **35.1** | **150** | **27.4** | **337** | **31.2** |
| **(ii) Leukaemia and Aleukaemia** | | | | | | |
| Under 30 | 14 | 5.3 | 5 | 1.9 | 19 | 3.6 |
| 30-39 | 2 | 2.3 | 2 | 2.3 | 4 | 2.3 |
| 40-49 | 1 | 1.7 | 1 | 1.7 | 2 | 1.7 |
| 50-59 | 6 | 12.5 | 1 | 2.0 | 7 | 7.2 |
| 60-69 | 12 | 28.1 | 9 | 18.1 | 21 | 22.7 |
| 70-79 | 19 | 68.5 | 14 | 39.2 | 33 | 52.0 |
| 80-89 | 8 | 85.1 | 7 | 44.0 | 15 | 59.2 |
| 90 and over | 5 | 384.6 | 4 | 125.0 | 9 | 200.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **67** | **12.5** | **43** | **7.8** | **110** | **10.1** |

## TABLE IV M (CONT'D)

| | | | | | | |
|---|---|---|---|---|---|---|
| **(iii) Hodgkins Disease** | | | | | | |
| Under 30 | 9 | 3.4 | 6 | 2.3 | 15 | 2.8 |
| 30-39 | 2 | 2.3 | 4 | 4.7 | 6 | 3.5 |
| 40-49 | 0 | 0.0 | 1 | 1.7 | 1 | 0.8 |
| 50-59 | 2 | 4.1 | 2 | 4.0 | 4 | 4.1 |
| 60-69 | 4 | 9.3 | 1 | 2.0 | 5 | 5.4 |
| 70-79 | 1 | 3.6 | 2 | 5.6 | 3 | 4.7 |
| 80-89 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **18** | **3.3** | **16** | **2.9** | **34** | **3.1** |
| **(iv) Other Lymphomas** | | | | | | |
| Under 30 | 5 | 1.8 | 6 | 2.3 | 11 | 2.1 |
| 30-39 | 3 | 3.5 | 4 | 4.7 | 7 | 4.1 |
| 40-49 | 10 | 17.8 | 2 | 3.5 | 12 | 10.7 |
| 50-59 | 12 | 25.0 | 9 | 18.2 | 21 | 21.6 |
| 60-69 | 23 | 53.9 | 19 | 38.3 | 42 | 45.5 |
| 70-79 | 13 | 46.9 | 17 | 47.6 | 30 | 47.3 |
| 80-89 | 13 | 138.2 | 7 | 44.0 | 20 | 79.0 |
| 90 and over | 2 | 153.8 | 6 | 187.5 | 8 | 177.7 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **81** | **15.2** | **70** | **12.8** | **151** | **13.9** |
| **(v) Multiple Myeloma** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 2 | 2.3 | 0 | 0.0 | 2 | 1.1 |
| 40-49 | 3 | 5.3 | 0 | 0.0 | 3 | 2.6 |
| 50-59 | 1 | 2.0 | 3 | 6.0 | 4 | 4.1 |
| 60-69 | 5 | 11.7 | 5 | 10.0 | 10 | 10.8 |
| 70-79 | 6 | 21.6 | 8 | 22.4 | 14 | 22.0 |
| 80-89 | 3 | 31.9 | 5 | 31.4 | 8 | 31.6 |
| 90 and over | 1 | 76.9 | 0 | 0.0 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **21** | **3.9** | **21** | **3.8** | **42** | **3.8** |

## TABLE V

### INCIDENCE — SITES OF CANCER 1986

| ICDA 9TH REV. | Site | Male | Female | Total |
|---|---|---|---|---|
| | **Buccal Cavity and Pharynx** | | | |
| 140 | Lip | 54 | 13 | **67** |
| 141 | Tongue | 9 | 5 | **14** |
| 142 | Salivary Glands | 6 | 2 | **8** |
| 143 | Gums | 2 | 1 | **3** |
| 144 | Floor of the Mouth | 8 | 3 | **11** |
| 145 | Other parts of Mouth | 15 | 8 | **23** |
| 146 | Oropharynx | 5 | 4 | **9** |
| 147 | Nasopharynx | 1 | 2 | **3** |
| 148 | Hypopharynx | 5 | 1 | **6** |
| 149 | Pharynx Unspecified | 2 | 0 | **2** |
| | **Total** | **107** | **39** | **146** |
| | **Percent** | **3.4** | **1.1** | **2.2** |
| | **Digestive Organs** | | | |
| 150 | Oesophagus | 26 | 17 | **43** |
| 151 | Stomach | 93 | 56 | **149** |
| 152 | Small Intestines | 12 | 6 | **18** |
| 153 | Large Intestines | 225 | 216 | **441** |
| 154 | Rectum and recto-sigmoid Junction | 135 | 82 | **217** |
| 155 | Liver and Intrahepatic Ducts | 19 | 16 | **35** |
| 156 | Gall Bladder and Extrahepatic Ducts | 18 | 22 | **40** |
| 157 | Pancreas | 57 | 52 | **109** |
| 158 | Peritoneum and Retroperitoneal Tissue | 5 | 6 | **11** |
| 159 | Digestive — N.O.S. | 1 | 1 | **2** |
| | **Total** | **591** | **474** | **1, 065** |
| | **Percent** | **19.3** | **15.5** | **17.4** |
| | **Respiratory System** | | | |
| 160 | Nose, Nasal Cavities, Ear and Accessory | 2 | 4 | **6** |
| 161 | Larynx | 40 | 6 | **46** |
| 162 | Trachea, Bronchus and Lung | 448 | 216 | **664** |
| 163-165 | Other and Unspecified Respiratory Organs | 4 | 0 | **4** |
| | **Total** | **494** | **226** | **720** |
| | **Percent** | **16.2** | **7.4** | **11.8** |

## TABLE V (CONT'D)

| ICDA 9TH REV. | Site | Male | Female | Total |
|---|---|---|---|---|
| | **Breast and Genito-Urinary Organs** | | | |
| 174-175 | Breast | 6 | 575 | **581** |
| 180, 233.1 | Cervix Uteri | 0 | 435 | **435** |
| 179-182, | Uterus-Corpus except Cervix | 0 | 128 | **128** |
| 183 | Ovary, Fallopian Tubes and Broad Ligaments | 0 | 65 | **65** |
| 184, 236.1 | Other Female Genital Organs | 0 | 28 | **28** |
| 185 | Prostate | 481 | 0 | **481** |
| 186 | Testis | 23 | 0 | **23** |
| 187 | Other Male Genital Organs | 4 | 0 | **4** |
| 188 | Bladder | 151 | 48 | **199** |
| 189 | Other and Unspecified Urinary Organs | 49 | 36 | **85** |
| | **Total** | **714** | **1,315** | **2,029** |
| | **Percent** | **23.3** | **42.8** | **33.0** |
| | **Other and Unspecified Sites** | | | |
| 172 | Malignant Melanoma of Skin | 16 | 41 | **57** |
| 173 | Malignant Neoplasm of Skin | 774 | 617 | **1,391** |
| 190 | Eye | 3 | 3 | **6** |
| 191 | Brain | 26 | 28 | **54** |
| 192 | Other Parts of Nervous System | 7 | 0 | **7** |
| 193 | Thyroid Glands | 16 | 29 | **45** |
| 194, 164.0 | Endocrine Glands | 4 | 0 | **4** |
| 170 | Bones | 6 | 7 | **13** |
| 171 | Connective Tissue | 13 | 12 | **25** |
| 195-9 | Other and Unspecified Sites | 78 | 87 | **165** |
| | **Total** | **943** | **824** | **1,767** |
| | **Percent** | **30.9** | **27.1** | **29.0** |

## TABLE V (CONT'D)

| ICDA 9TH REV. | Site | Male | Female | Total |
|---|---|---|---|---|
| | **Lymphatic and Haematopoietic System** | | | |
| 200 | Lymphosarcoma and Reticulosarcoma | 38 | 29 | 67 |
| 201 | Hodgkins Disease | 18 | 16 | 34 |
| 202 | Other Lymphomas (Recticulosis) | 43 | 41 | 84 |
| 203 | Multiple Myeloma | 21 | 21 | 42 |
| 204-8 | Leukaemia and Aleukemia | 67 | 43 | 110 |
| 238.4 | Polycythemia Vera | 7 | 4 | 11 |
| 289.0 | Myelofibrosis | 7 | 3 | 10 |
| | **Total** | **201** | **157** | **358** |
| | **Percent** | **6.5** | **5.1** | **5.8** |
| | TOTAL — ALL SITES | **3,050** | **3,035** | **6,085** |
| | **Percent** | **100.0** | **100.0** | **100.0** |

## TABLE VI
### MORTALITY — PLACE OF DEATH OF CANCER PATIENTS 1986

| Place of Death | Male | Female | Total |
|---|---|---|---|
| Hospitals — Greater Winnipeg | 754 | 589 | 1,343 |
| Hospitals — Outside Greater Winnipeg | 329 | 272 | 601 |
| Nursing Homes | 7 | 9 | 16 |
| Other — Greater Winnipeg | 69 | 73 | 142 |
| Other — Outside Greater Winnipeg | 80 | 73 | 153 |
| **Total** | **1,239** | **1,016** | **2,255** |

## TABLE VII
### MORTALITY — RESIDENCE OF CANCER DEATHS 1986

| Residence | Male | Female | Total |
|---|---|---|---|
| Greater Winnipeg | 813 | 651 | 1,464 |
| Manitoba, Outside Greater Winnipeg | 402 | 338 | 740 |
| Other Provinces | 22 | 24 | 46 |
| United States of America | 1 | 1 | 2 |
| Outside Canada and U.S.A. | 1 | 2 | 3 |
| Residence Not Stated | 0 | 0 | 0 |
| **Total** | **1,239** | **1,016** | **2,255** |

# TABLE VIII

## MORTALITY
## RESIDENTIAL DISTRIBUTION OF PATIENTS DYING OF CANCER 1986

| Residence | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Division 1 | 5 | 59.4 | 10 | 128.3 | 15 | 92.6 |
| Division 2 | 27 | 140.6 | 17 | 92.0 | 44 | 116.8 |
| Division 3 | 34 | 185.3 | 25 | 135.2 | 59 | 160.2 |
| Division 4 | 13 | 216.1 | 8 | 140.3 | 21 | 179.2 |
| Division 5 | 12 | 139.7 | 21 | 249.2 | 33 | 194.0 |
| Division 6 | 7 | 129.1 | 4 | 74.4 | 11 | 101.9 |
| Division 7 | 77 | 290.0 | 66 | 236.7 | 143 | 262.7 |
| Division 8 | 11 | 144.1 | 8 | 111.0 | 19 | 128.0 |
| Division 9 | 35 | 298.3 | 28 | 238.0 | 63 | 268.1 |
| Division 10 | 0 | 0.0 | 2 | 59.9 | 2 | 28.5 |
| Division 11 | 813 | 299.0 | 651 | 222.5 | 1,464 | 259.3 |
| Division 12 | 15 | 196.7 | 8 | 111.4 | 23 | 155.4 |
| Division 13 | 19 | 120.7 | 27 | 175.8 | 46 | 147.9 |
| Division 14 | 10 | 139.5 | 5 | 76.2 | 15 | 109.2 |
| Division 15 | 36 | 286.6 | 24 | 197.1 | 60 | 242.5 |
| Division 16 | 11 | 190.3 | 9 | 162.0 | 20 | 176.4 |
| Division 17 | 39 | 275.1 | 30 | 215.2 | 69 | 245.4 |
| Division 18 | 18 | 160.4 | 17 | 160.9 | 35 | 160.6 |
| Division 19 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Division 20 | 14 | 217.7 | 11 | 179.1 | 25 | 198.8 |
| Division 21 | 12 | 94.1 | 11 | 91.8 | 23 | 93.0 |
| Division 22 | 6 | 43.1 | 6 | 46.9 | 12 | 44.9 |
| Division 23 | 1 | 18.8 | 1 | 21.5 | 2 | 19.9 |
| **Total** | **1,215** | **239.8** | **989** | **190.2** | **2,204** | **214.7** |

Based on Statistics Canada 1981 Census Data.

# TABLE IX

## MORTALITY
## AGE AND SEX DISTRIBUTION OF TOTAL CANCER DEATHS 1986

| Age Group | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| 0-4 | 1 | 2.3 | 1 | 2.5 | 2 | 2.4 |
| 5-9 | 4 | 10.0 | 0 | 0.0 | 4 | 5.1 |
| 10-14 | 2 | 4.8 | 1 | 2.5 | 3 | 3.7 |
| 15-19 | 3 | 7.0 | 1 | 2.4 | 4 | 4.8 |
| 20-24 | 3 | 6.0 | 1 | 2.0 | 4 | 4.0 |
| 25-29 | 3 | 6.1 | 5 | 10.4 | 8 | 8.2 |
| 30-34 | 5 | 11.4 | 10 | 22.7 | 15 | 17.1 |
| 35-39 | 10 | 25.2 | 12 | 30.1 | 22 | 27.7 |
| 40-44 | 17 | 55.5 | 31 | 101.6 | 48 | 78.5 |
| 45-49 | 37 | 146.2 | 32 | 127.4 | 69 | 136.9 |
| 50-54 | 56 | 232.3 | 48 | 198.3 | 104 | 215.3 |
| 55-59 | 91 | 382.3 | 87 | 346.6 | 178 | 364.0 |
| 60-64 | 131 | 569.5 | 104 | 390.9 | 235 | 473.7 |
| 65-69 | 184 | 938.7 | 106 | 460.8 | 290 | 680.7 |
| 70-74 | 209 | 1,259.0 | 159 | 771.8 | 368 | 989.2 |
| 75-79 | 176 | 1,585.5 | 133 | 880.7 | 309 | 1,179.3 |
| 80-84 | 153 | 2,283.5 | 123 | 1,194.1 | 276 | 1,623.5 |
| 85-89 | 83 | 3,074.0 | 86 | 1,535.7 | 169 | 2,036.1 |
| 90 and over | 47 | 3,615.3 | 49 | 1,531.2 | 96 | 2,133.3 |
| Unknown | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **1,215** | **228.3** | **989** | **180.9** | **2,204** | **204.3** |

# TABLE IX A

## MORTALITY
## AGE AND SEX ANALYSIS — BUCCAL CAVITY AND PHARNYX 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | 1 | 0.1 |
| 30-39 | 0 | 0.0 | 1 | 1.1 | 1 | 0.5 |
| 40-49 | 1 | 1.7 | 0 | 0.0 | 1 | 0.8 |
| 50-59 | 6 | 12.5 | 1 | 2.0 | 7 | 7.2 |
| 60-69 | 5 | 11.7 | 4 | 8.0 | 9 | 9.7 |
| 70-79 | 9 | 32.4 | 5 | 14.0 | 14 | 22.0 |
| 80-89 | 3 | 31.9 | 2 | 12.5 | 5 | 19.7 |
| 90 and over | 0 | 0.0 | 1 | 31.2 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **24** | **4.5** | **15** | **2.7** | **39** | **3.6** |
| **(ii) Lip** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 60-69 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 70-79 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 80-89 | 1 | 10.6 | 0 | 0.0 | 1 | 3.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **1** | **0.1** | **0** | **0.0** | **1** | **0.0** |

# TABLE IX B

## MORTALITY
## AGE AND SEX ANALYSIS — DIGESTIVE SYSTEM 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 2 | 0.7 | 1 | 0.3 | 3 | 0.5 |
| 30-39 | 6 | 7.1 | 9 | 10.7 | 15 | 8.9 |
| 40-49 | 17 | 30.4 | 8 | 14.3 | 25 | 22.4 |
| 50-59 | 40 | 83.5 | 25 | 50.7 | 65 | 66.8 |
| 60-69 | 91 | 213.6 | 63 | 127.0 | 154 | 167.0 |
| 70-79 | 107 | 386.2 | 85 | 238.0 | 192 | 302.8 |
| 80-89 | 60 | 638.2 | 83 | 522.0 | 143 | 565.2 |
| 90 and over | 7 | 538.4 | 14 | 437.5 | 21 | 466.6 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **330** | **62.0** | **288** | **52.6** | **618** | **57.2** |
| **(ii) Oesophagus** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 1 | 1.7 | 1 | 0.8 |
| 50-59 | 6 | 12.5 | 0 | 0.0 | 6 | 6.1 |
| 60-69 | 12 | 28.1 | 2 | 4.0 | 14 | 15.1 |
| 70-79 | 9 | 32.4 | 5 | 14.0 | 14 | 22.0 |
| 80-89 | 5 | 53.1 | 4 | 25.1 | 9 | 35.5 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **32** | **6.0** | **12** | **2.1** | **44** | **4.0** |
| **(iii) Stomach** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 1 | 1.1 | 0 | 0.0 | 1 | 0.5 |
| 40-49 | 4 | 7.1 | 0 | 0.0 | 4 | 3.5 |
| 50-59 | 7 | 14.6 | 4 | 8.1 | 11 | 11.3 |
| 60-69 | 9 | 21.1 | 7 | 14.1 | 16 | 17.3 |
| 70-79 | 24 | 86.6 | 12 | 33.6 | 36 | 56.7 |
| 80-89 | 12 | 127.6 | 16 | 100.6 | 28 | 110.6 |
| 90 and over | 0 | 0.0 | 2 | 62.5 | 2 | 44.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **57** | **10.7** | **41** | **7.5** | **98** | **9.0** |

## TABLE IX B (CONT'D)

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(iv) Large Intestine** | | | | | | |
| Under 30 | 1 | 0.3 | 1 | 0.3 | 2 | 0.3 |
| 30-39 | 0 | 0.0 | 6 | 7.1 | 6 | 3.5 |
| 40-49 | 4 | 7.1 | 2 | 3.5 | 6 | 5.3 |
| 50-59 | 5 | 10.4 | 3 | 6.0 | 8 | 8.2 |
| 60-69 | 24 | 56.3 | 20 | 40.3 | 44 | 47.7 |
| 70-79 | 24 | 86.6 | 29 | 81.2 | 53 | 83.5 |
| 80-89 | 17 | 180.8 | 23 | 144.6 | 40 | 158.1 |
| 90 and over | 2 | 153.8 | 2 | 62.5 | 4 | 88.8 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **77** | **14.4** | **86** | **15.7** | **163** | **15.1** |
| **(v) Rectum and Recto-Sigmoid Junction** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 1 | 1.1 | 0 | 0.0 | 1 | 0.5 |
| 40-49 | 1 | 1.7 | 1 | 1.7 | 2 | 1.7 |
| 50-59 | 5 | 10.4 | 4 | 8.1 | 9 | 9.2 |
| 60-69 | 10 | 23.4 | 9 | 18.1 | 19 | 20.6 |
| 70-79 | 15 | 54.1 | 7 | 19.6 | 22 | 34.7 |
| 80-89 | 8 | 85.1 | 11 | 69.1 | 19 | 75.0 |
| 90 and over | 3 | 230.7 | 2 | 62.5 | 5 | 111.1 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **43** | **8.0** | **34** | **6.2** | **77** | **7.1** |

## TABLE IX B (CONT'D)

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(vi) Liver and Biliary Passages** | | | | | | |
| Under 30 | 1 | 0.3 | 0 | 0.0 | 1 | 0.1 |
| 30-39 | 1 | 1.1 | 2 | 2.3 | 3 | 1.7 |
| 40-49 | 2 | 3.5 | 1 | 1.7 | 3 | 2.6 |
| 50-59 | 7 | 14.6 | 2 | 4.0 | 9 | 9.2 |
| 60-69 | 12 | 28.1 | 5 | 10.0 | 17 | 18.4 |
| 70-79 | 10 | 36.1 | 9 | 25.2 | 19 | 29.9 |
| 80-89 | 6 | 63.8 | 9 | 56.6 | 15 | 59.2 |
| 90 and over | 0 | 0.0 | 3 | 93.7 | 3 | 66.6 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 39 | 7.3 | 31 | 5.6 | 70 | 6.4 |
| **(vii) Pancreas** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 1 | 1.1 | 0 | 0.0 | 1 | 0.5 |
| 40-49 | 4 | 7.1 | 1 | 1.7 | 5 | 4.4 |
| 50-59 | 8 | 16.7 | 8 | 16.2 | 16 | 16.4 |
| 60-69 | 15 | 35.2 | 14 | 28.2 | 29 | 31.4 |
| 70-79 | 16 | 57.7 | 16 | 44.8 | 32 | 50.4 |
| 80-89 | 12 | 127.6 | 10 | 62.8 | 22 | 86.9 |
| 90 and over | 1 | 76.9 | 4 | 125.0 | 5 | 111.1 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 57 | 10.7 | 53 | 9.6 | 110 | 10.1 |

# TABLE IX C

## MORTALITY
## AGE AND SEX ANALYSIS — RESPIRATORY SYSTEM 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | 1 | 0.1 |
| 30-39 | 0 | 0.0 | 1 | 1.1 | 1 | 0.5 |
| 40-49 | 18 | 32.2 | 10 | 17.9 | 28 | 25.1 |
| 50-59 | 58 | 121.0 | 32 | 64.9 | 90 | 92.5 |
| 60-69 | 137 | 321.5 | 37 | 74.5 | 174 | 188.7 |
| 70-79 | 136 | 490.9 | 46 | 128.8 | 182 | 287.0 |
| 80-89 | 61 | 648.9 | 16 | 100.6 | 77 | 304.3 |
| 90 and over | 14 | 1,076.9 | 3 | 93.7 | 17 | 377.7 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **424** | **79.6** | **146** | **26.7** | **570** | **52.8** |
| **(ii) Larynx** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 1 | 1.7 | 0 | 0.0 | 1 | 0.8 |
| 50-59 | 1 | 2.0 | 0 | 0.0 | 1 | 1.0 |
| 60-69 | 5 | 11.7 | 1 | 2.0 | 6 | 6.5 |
| 70-79 | 4 | 14.4 | 2 | 5.6 | 6 | 9.4 |
| 80-89 | 3 | 31.9 | 0 | 0.0 | 3 | 11.8 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **14** | **2.6** | **3** | **0.5** | **17** | **1.5** |
| **(iii) Trachea, Bronchus, and Lung** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | 1 | 0.1 |
| 30-39 | 0 | 0.0 | 1 | 1.1 | 1 | 0.5 |
| 40-49 | 16 | 28.6 | 10 | 17.9 | 26 | 23.3 |
| 50-59 | 57 | 118.9 | 32 | 64.9 | 89 | 91.5 |
| 60-69 | 129 | 302.8 | 34 | 68.5 | 163 | 176.7 |
| 70-79 | 130 | 469.3 | 43 | 120.4 | 173 | 272.8 |
| 80-89 | 56 | 595.7 | 15 | 94.3 | 71 | 280.6 |
| 90 and over | 13 | 1,000.0 | 3 | 93.7 | 16 | 355.5 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **401** | **75.3** | **139** | **25.4** | **540** | **50.0** |

## TABLE IX D

### MORTALITY
### AGE AND SEX ANALYSIS — BREAST 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Under 30 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 30-39 | 0 | 0.0 | 5 | 5.9 | **5** | **2.9** |
| 40-49 | 0 | 0.0 | 23 | 41.3 | **23** | **20.6** |
| 50-59 | 0 | 0.0 | 38 | 77.0 | **38** | **39.0** |
| 60-69 | 2 | 4.6 | 49 | 98.7 | **51** | **55.3** |
| 70-79 | 0 | 0.0 | 57 | 159.6 | **57** | **89.9** |
| 80-89 | 0 | 0.0 | 36 | 226.4 | **36** | **142.2** |
| 90 and over | 0 | 0.0 | 8 | 250.0 | **8** | **177.7** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **2** | **0.3** | **216** | **39.5** | **218** | **20.2** |

## TABLE IX E

### MORTALITY
### AGE AND SEX ANALYSIS — FEMALE GENITAL ORGANS 1986

| | Female | Rate | | Female | Rate |
|---|---|---|---|---|---|
| **(i) All organs** | | | **(ii) Cervix Uteri** | | |
| Under 30 | 1 | 0.3 | Under 30 | 1 | 0.3 |
| 30-39 | 1 | 1.1 | 30-39 | 1 | 1.1 |
| 40-49 | 6 | 10.7 | 40-49 | 4 | 7.1 |
| 50-59 | 14 | 28.3 | 50-59 | 3 | 6.0 |
| 60-69 | 18 | 36.2 | 60-69 | 6 | 12.0 |
| 70-79 | 28 | 78.4 | 70-79 | 3 | 8.4 |
| 80-89 | 16 | 100.6 | 80-89 | 2 | 12.5 |
| 90 and over | 6 | 187.5 | 90 and over | 1 | 31.2 |
| Age not stated | 0 | 0.0 | Age not stated | 0 | 0.0 |
| **Total** | **90** | **16.4** | **Total** | **21** | **3.8** |
| **(iii) Uterus-Corpus etc. (Except Cervix)** | | | **(iv) Ovaries, Fallopian Tubes, Broad Ligaments and other Genital Organs** | | |
| Under 30 | 0 | 0.0 | Under 30 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 30-39 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 40-49 | 2 | 3.5 |
| 50-59 | 1 | 2.0 | 50-59 | 10 | 20.2 |
| 60-69 | 1 | 2.0 | 60-69 | 11 | 22.1 |
| 70-79 | 11 | 30.8 | 70-79 | 14 | 39.2 |
| 80-89 | 7 | 44.0 | 80-89 | 7 | 44.0 |
| 90 and over | 3 | 93.7 | 90 and over | 2 | 62.5 |
| Age not stated | 0 | 0.0 | Age not stated | 0 | 0.0 |
| **Total** | **23** | **4.2** | **Total** | **46** | **8.4** |

# TABLE IX F

## MORTALITY
## AGE AND SEX ANALYSIS — MALE GENITAL ORGANS 1986

| | Male | Rate | | Male | Rate |
|---|---|---|---|---|---|
| **(i) All Organs** | | | **(ii) Prostate** | | |
| Under 30 | 1 | 0.3 | Under 30 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 30-39 | 0 | 0.0 |
| 40-49 | 2 | 3.5 | 40-49 | 1 | 1.7 |
| 50-59 | 7 | 14.6 | 50-59 | 7 | 14.6 |
| 60-69 | 25 | 58.6 | 60-69 | 24 | 56.3 |
| 70-79 | 49 | 176.8 | 70-79 | 48 | 173.2 |
| 80-89 | 56 | 595.7 | 80-89 | 56 | 595.7 |
| 90 and over | 17 | 1,307.6 | 90 and over | 17 | 1,307.6 |
| Age not stated | 0 | 0.0 | Age not stated | 0 | 0.0 |
| **Total** | **157** | **29.5** | **Total** | **153** | **28.7** |

| | Male | Rate |
|---|---|---|
| **(iii) Other Male Genital Organs** | | |
| Under 30 | 1 | 0.3 |
| 30-39 | 0 | 0.0 |
| 40-49 | 1 | 1.7 |
| 50-59 | 0 | 0.0 |
| 60-69 | 1 | 2.3 |
| 70-79 | 1 | 3.6 |
| 80-89 | 0 | 0.0 |
| 90 and over | 0 | 0.0 |
| Age not stated | 0 | 0.0 |
| **Total** | **4** | **0.7** |

# TABLE IX G

## MORTALITY
## AGE AND SEX ANALYSIS — URINARY ORGANS 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 3 | 5.3 | 2 | 3.5 | 5 | 4.4 |
| 50-59 | 3 | 6.2 | 5 | 10.1 | 8 | 8.2 |
| 60-69 | 10 | 23.4 | 3 | 6.0 | 13 | 14.0 |
| 70-79 | 17 | 61.3 | 7 | 19.6 | 24 | 37.8 |
| 80-89 | 15 | 159.5 | 5 | 31.4 | 20 | 79.0 |
| 90 and over | 2 | 153.8 | 1 | 31.2 | 3 | 66.6 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **50** | **9.3** | **23** | **4.2** | **73** | **6.7** |
| **(ii) Bladder** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 1 | 1.7 | 0 | 0.0 | 1 | 0.8 |
| 50-59 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 60-69 | 6 | 14.0 | 1 | 2.0 | 7 | 7.5 |
| 70-79 | 9 | 32.4 | 0 | 0.0 | 9 | 14.1 |
| 80-89 | 13 | 138.2 | 3 | 18.8 | 16 | 63.2 |
| 90 and over | 1 | 76.9 | 1 | 31.2 | 2 | 44.4 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **30** | **5.6** | **5** | **0.9** | **35** | **3.2** |
| **(iii) Kidney** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 2 | 3.5 | 2 | 3.5 | 4 | 3.5 |
| 50-59 | 3 | 6.2 | 5 | 10.1 | 8 | 8.2 |
| 60-69 | 4 | 9.3 | 2 | 4.0 | 6 | 6.5 |
| 70-79 | 6 | 21.6 | 7 | 19.6 | 13 | 20.5 |
| 80-89 | 2 | 21.2 | 2 | 12.5 | 4 | 15.8 |
| 90 and over | 1 | 76.9 | 0 | 0.0 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **18** | **3.3** | **18** | **3.2** | **36** | **3.3** |

# TABLE IX H

## MORTALITY
## AGE AND SEX ANALYSIS — SKIN 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total Skin** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | 1 | 0.1 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 1 | 1.7 | 1 | 1.7 | 2 | 1.7 |
| 50-59 | 1 | 2.0 | 5 | 10.1 | 6 | 6.1 |
| 60-69 | 3 | 7.0 | 2 | 4.0 | 5 | 5.4 |
| 70-79 | 3 | 10.8 | 4 | 11.2 | 7 | 11.0 |
| 80-89 | 2 | 21.2 | 3 | 18.8 | 5 | 19.7 |
| 90 and over | 0 | 0.0 | 1 | 31.2 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **10** | **1.8** | **17** | **3.1** | **27** | **2.5** |
| **(ii) Melanoma** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | 1 | 0.1 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 1 | 1.7 | 1 | 1.7 | 2 | 1.7 |
| 50-59 | 1 | 2.0 | 3 | 6.0 | 4 | 4.1 |
| 60-69 | 3 | 7.0 | 1 | 2.0 | 4 | 4.3 |
| 70-79 | 3 | 10.8 | 3 | 8.4 | 6 | 9.4 |
| 80-89 | 2 | 21.2 | 3 | 18.8 | 5 | 19.7 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **10** | **1.8** | **12** | **2.1** | **22** | **2.0** |
| **(iii) Other Malignant Neoplasms** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 0 | 0.0 | 2 | 4.0 | 2 | 2.0 |
| 60-69 | 0 | 0.0 | 1 | 2.0 | 1 | 1.0 |
| 70-79 | 0 | 0.0 | 1 | 2.8 | 1 | 1.5 |
| 80-89 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 90 and over | 0 | 0.0 | 1 | 31.2 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | **0** | **0.0** | **5** | **0.9** | **5** | **0.4** |

## TABLE IX I

### MORTALITY
### AGE AND SEX ANALYSIS — BRAIN AND NERVOUS SYSTEM 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 2 | 0.7 | 0 | 0.0 | 2 | 0.3 |
| 30-39 | 3 | 3.5 | 0 | 0.0 | 3 | 1.7 |
| 40-49 | 5 | 8.9 | 1 | 1.7 | 6 | 5.3 |
| 50-59 | 1 | 2.0 | 2 | 4.0 | 3 | 3.0 |
| 60-69 | 8 | 18.7 | 4 | 8.0 | 12 | 13.0 |
| 70-79 | 3 | 10.8 | 5 | 14.0 | 8 | 12.6 |
| 80-89 | 1 | 10.6 | 1 | 6.2 | 2 | 7.9 |
| 90 and over | 0 | 0.0 | 1 | 31.2 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 23 | 4.3 | 14 | 2.5 | 37 | 3.4 |
| **(ii) Brain** | | | | | | |
| Under 30 | 2 | 0.7 | 0 | 0.0 | 2 | 0.3 |
| 30-39 | 3 | 3.5 | 0 | 0.0 | 3 | 1.7 |
| 40-49 | 5 | 8.9 | 1 | 1.7 | 6 | 5.3 |
| 50-59 | 0 | 0.0 | 2 | 4.0 | 2 | 2.0 |
| 60-69 | 8 | 18.7 | 4 | 8.0 | 12 | 13.0 |
| 70-79 | 3 | 10.8 | 5 | 14.0 | 8 | 12.6 |
| 80-89 | 1 | 10.6 | 1 | 6.2 | 2 | 7.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 22 | 4.1 | 13 | 2.3 | 35 | 3.2 |
| **(iii) Other Parts of Nervous System** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 1 | 2.0 | 0 | 0.0 | 1 | 1.0 |
| 60-69 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 70-79 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 80-89 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 90 and over | 0 | 0.0 | 1 | 31.2 | 1 | 22.2 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 1 | 0.1 | 1 | 0.1 | 2 | 0.1 |

# TABLE IX J

## MORTALITY
## AGE AND SEX ANALYSIS — THYROID AND ENDOCRINE GLANDS 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 2 | 2.3 | 2 | 1.1 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 2 | 4.1 | 0 | 0.0 | 2 | 2.0 |
| 60-69 | 1 | 2.3 | 0 | 0.0 | 1 | 1.0 |
| 70-79 | 2 | 7.2 | 3 | 8.4 | 5 | 7.8 |
| 80-89 | 1 | 10.6 | 0 | 0.0 | 1 | 3.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 6 | 1.1 | 5 | 0.9 | 11 | 1.0 |
| **(ii) Thyroid Glands** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 2 | 4.1 | 0 | 0.0 | 2 | 2.0 |
| 60-69 | 1 | 2.3 | 0 | 0.0 | 1 | 1.0 |
| 70-79 | 1 | 3.6 | 3 | 8.4 | 4 | 6.3 |
| 80-89 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 4 | 0.7 | 3 | 0.5 | 7 | 0.6 |

## TABLE IX K

### MORTALITY
### AGE AND SEX ANALYSIS — BONES 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Under 30 | 1 | 0.3 | 0 | 0.0 | 1 | 0.1 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 1 | 1.7 | 1 | 0.8 |
| 50-59 | 2 | 4.1 | 1 | 2.0 | 3 | 3.0 |
| 60-69 | 1 | 2.3 | 0 | 0.0 | 1 | 1.0 |
| 70-79 | 1 | 3.6 | 0 | 0.0 | 1 | 1.5 |
| 80-89 | 1 | 10.6 | 0 | 0.0 | 1 | 3.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 6 | 1.1 | 2 | 0.3 | 8 | 0.7 |

## TABLE IX L

### MORTALITY
### AGE AND SEX ANALYSIS — CONNECTIVE TISSUE 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| Under 30 | 2 | 0.7 | 0 | 0.0 | 2 | 0.3 |
| 30-39 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 40-49 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| 50-59 | 0 | 0.0 | 3 | 6.0 | 3 | 3.0 |
| 60-69 | 4 | 9.3 | 3 | 6.0 | 7 | 7.5 |
| 70-79 | 1 | 3.6 | 4 | 11.2 | 5 | 7.8 |
| 80-89 | 0 | 0.0 | 2 | 12.5 | 2 | 7.9 |
| 90 and over | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Age not stated | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| **Total** | 7 | 1.3 | 12 | 2.1 | 19 | 1.7 |

## TABLE IX M

### MORTALITY
### AGE AND SEX ANALYSIS — LYMPHATIC SYSTEM AND HAEMATOPOIETIC TISSUE 1986

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(i) Total System** | | | | | | |
| Under 30 | 7 | 2.6 | 4 | 1.5 | **11** | **2.1** |
| 30-39 | 6 | 7.1 | 2 | 2.3 | **8** | **4.7** |
| 40-49 | 6 | 10.7 | 3 | 5.3 | **9** | **8.0** |
| 50-59 | 13 | 27.1 | 5 | 10.1 | **18** | **18.5** |
| 60-69 | 15 | 35.2 | 17 | 34.2 | **32** | **34.7** |
| 70-79 | 37 | 133.5 | 25 | 70.0 | **62** | **97.7** |
| 80-89 | 23 | 244.6 | 19 | 119.4 | **42** | **166.0** |
| 90 and over | 7 | 538.4 | 12 | 375.0 | **19** | **422.2** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **114** | **21.4** | **87** | **15.9** | **201** | **18.6** |
| **(ii) Leukaemia and Aleukaemia** | | | | | | |
| Under 30 | 7 | 2.6 | 1 | 0.3 | **8** | **1.5** |
| 30-39 | 3 | 3.5 | 0 | 0.0 | **3** | **1.7** |
| 40-49 | 3 | 5.3 | 1 | 1.7 | **4** | **3.5** |
| 50-59 | 3 | 6.2 | 2 | 4.0 | **5** | **5.1** |
| 60-69 | 5 | 11.7 | 8 | 16.1 | **13** | **14.0** |
| 70-79 | 19 | 68.5 | 10 | 28.0 | **29** | **45.7** |
| 80-89 | 8 | 85.1 | 6 | 37.7 | **14** | **55.3** |
| 90 and over | 3 | 230.7 | 5 | 156.2 | **8** | **177.7** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **51** | **9.5** | **33** | **6.0** | **84** | **7.7** |
| **(iii) Hodgkins Disease** | | | | | | |
| Under 30 | 0 | 0.0 | 1 | 0.3 | **1** | **0.1** |
| 30-39 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 40-49 | 1 | 1.7 | 0 | 0.0 | **1** | **0.8** |
| 50-59 | 1 | 2.0 | 0 | 0.0 | **1** | **1.0** |
| 60-69 | 1 | 2.3 | 1 | 2.0 | **2** | **2.1** |
| 70-79 | 1 | 3.6 | 0 | 0.0 | **1** | **1.5** |
| 80-89 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 90 and over | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **4** | **0.7** | **2** | **0.3** | **6** | **0.5** |

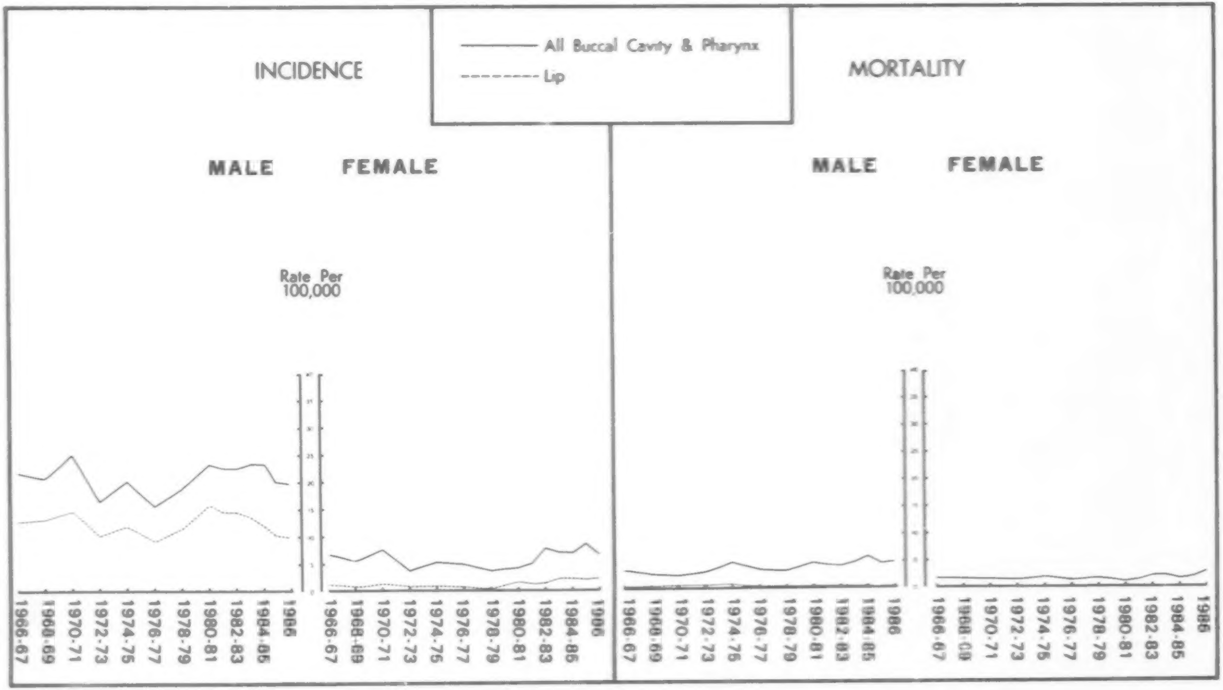
## TABLE IX M (CONT'D)

| | Male | Rate | Female | Rate | Total | Rate |
|---|---|---|---|---|---|---|
| **(iv) Other Lymphomas** | | | | | | |
| Under 30 | 0 | 0.0 | 2 | 0.7 | **2** | **0.3** |
| 30-39 | 3 | 3.5 | 0 | 0.0 | **3** | **1.7** |
| 40-49 | 1 | 1.7 | 2 | 3.5 | **3** | **2.6** |
| 50-59 | 6 | 12.5 | 2 | 4.0 | **8** | **8.2** |
| 60-69 | 6 | 14.0 | 4 | 8.0 | **10** | **10.8** |
| 70-79 | 6 | 21.6 | 9 | 25.2 | **15** | **23.6** |
| 80-89 | 12 | 127.6 | 9 | 56.6 | **21** | **83.0** |
| 90 and over | 2 | 153.8 | 6 | 187.5 | **8** | **177.7** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **36** | **6.7** | **34** | **6.2** | **70** | **6.4** |
| **(v) Multiple Myeloma** | | | | | | |
| Under 30 | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| 30-39 | 0 | 0.0 | 2 | 2.3 | **2** | **1.1** |
| 40-49 | 1 | 1.7 | 0 | 0.0 | **1** | **0.8** |
| 50-59 | 3 | 6.2 | 1 | 2.0 | **4** | **4.1** |
| 60-69 | 3 | 7.0 | 4 | 8.0 | **7** | **7.5** |
| 70-79 | 11 | 39.7 | 6 | 16.8 | **17** | **26.8** |
| 80-89 | 3 | 31.9 | 4 | 25.1 | **7** | **27.6** |
| 90 and over | 2 | 153.8 | 1 | 31.2 | **3** | **66.6** |
| Age not stated | 0 | 0.0 | 0 | 0.0 | **0** | **0.0** |
| **Total** | **23** | **4.3** | **18** | **3.2** | **41** | **3.8** |

# TRENDS IN CANCER
# MANITOBA 1966-1986

BUCCAL CAVITY AND PHARYNX

FIGURE 1



**DIGESTIVE SYSTEM** **FIGURE 1** (Cont'd.)

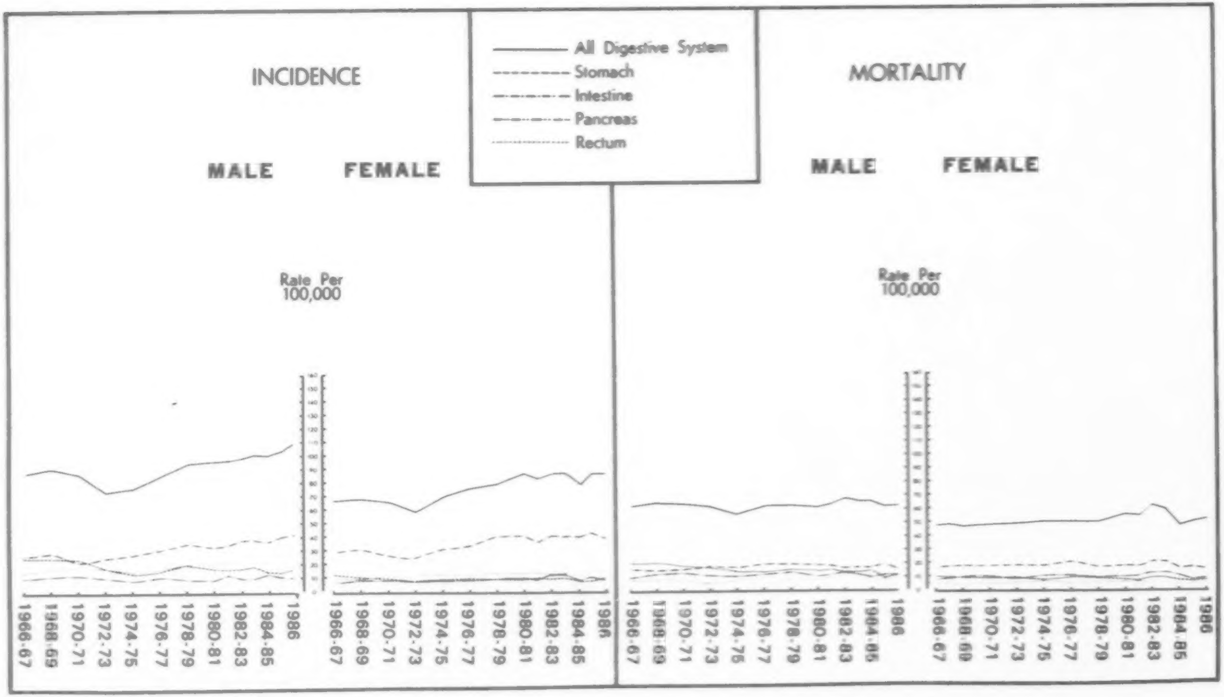
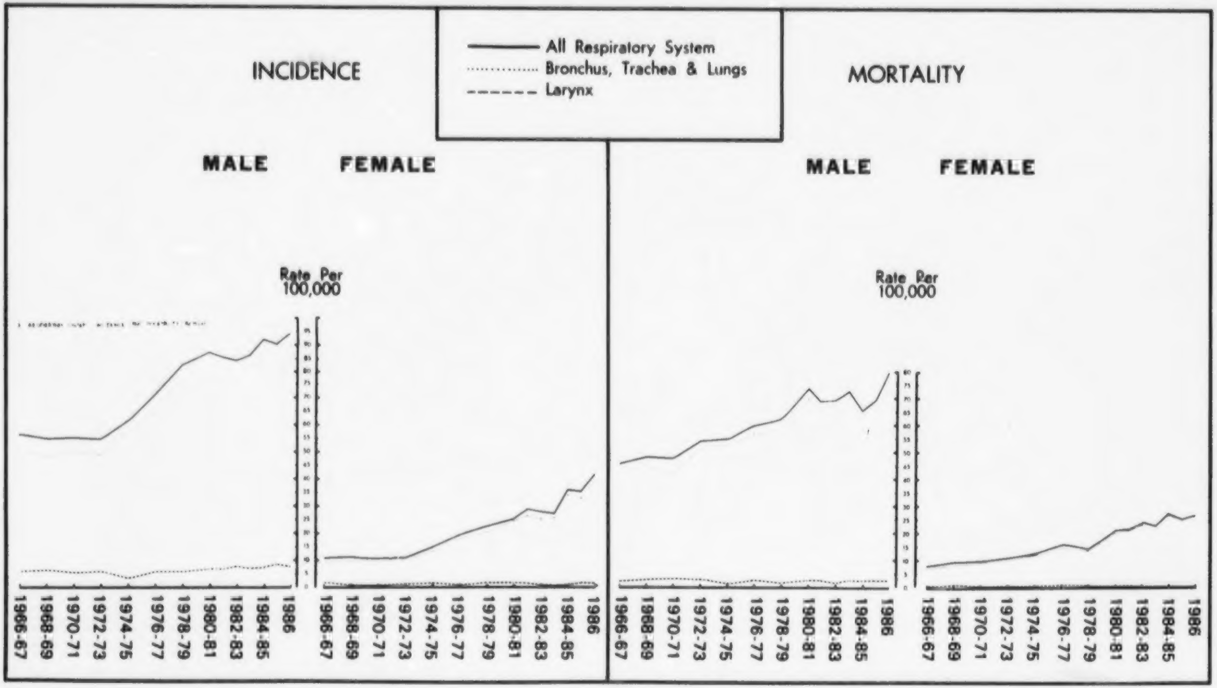


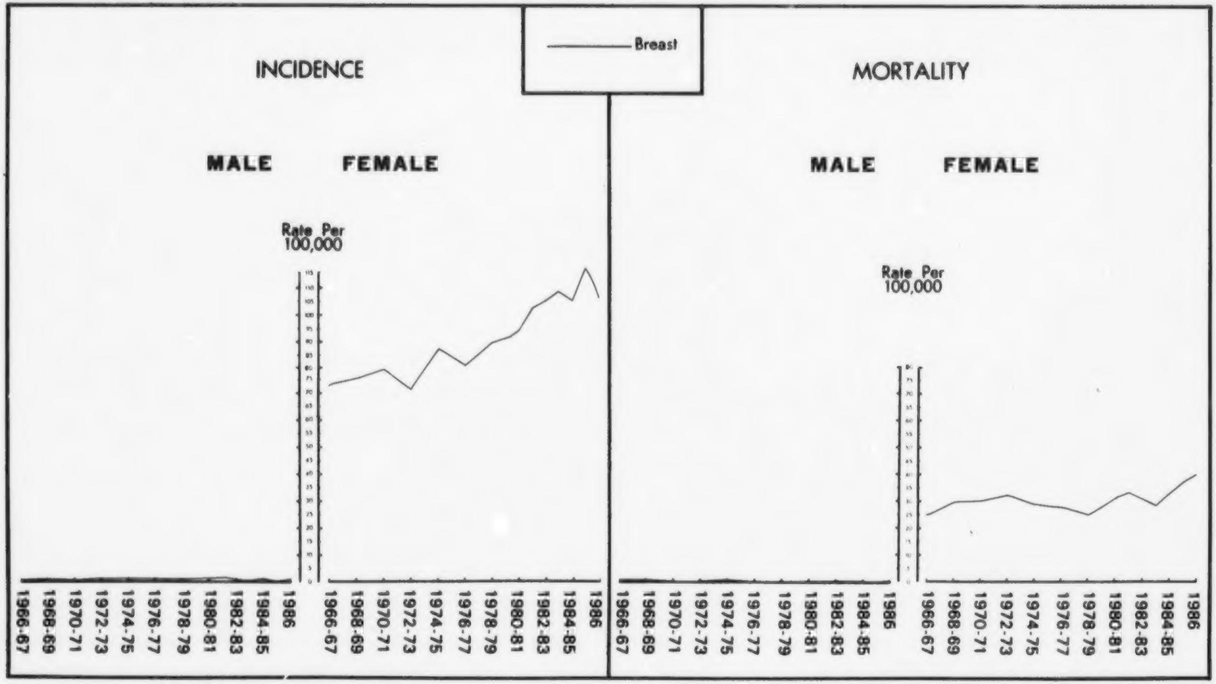
**FIGURE 1 (Cont'd.)**

## RESPIRATORY SYSTEM



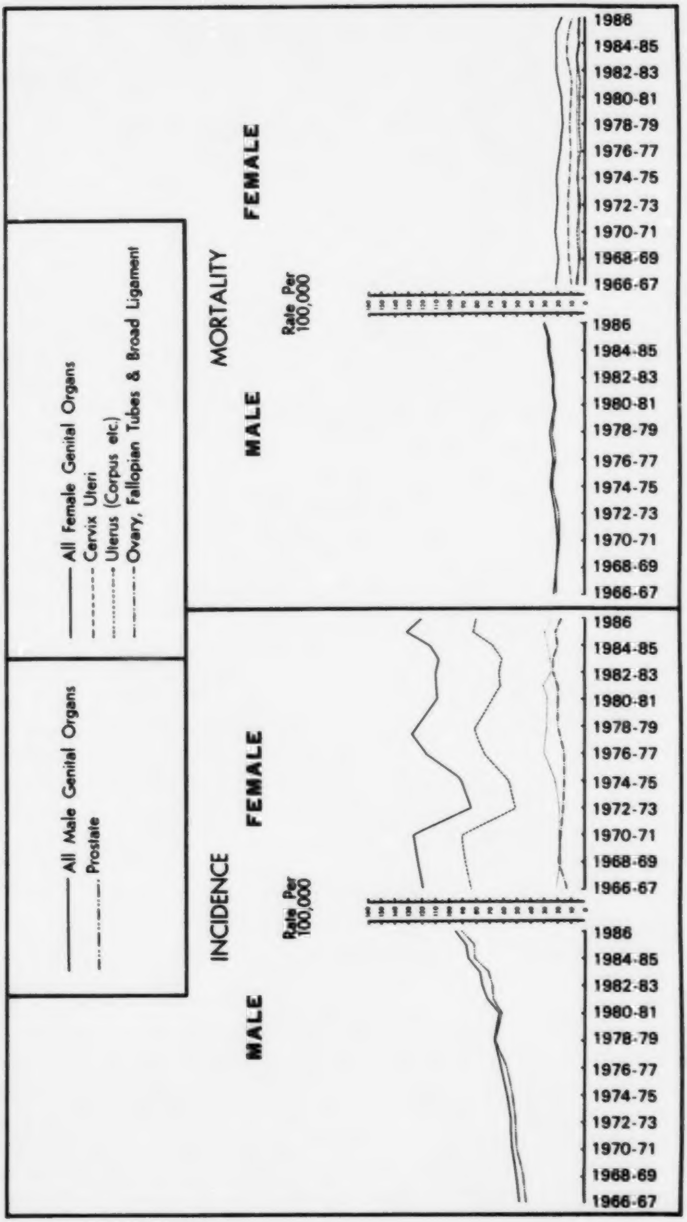
**BREAST**

**FIGURE 1** (Cont'd.)



GENITAL ORGANS

FIGURE 1 (Cont'd.)



## URINARY ORGANS

FIGURE 1 (Cont'd.)

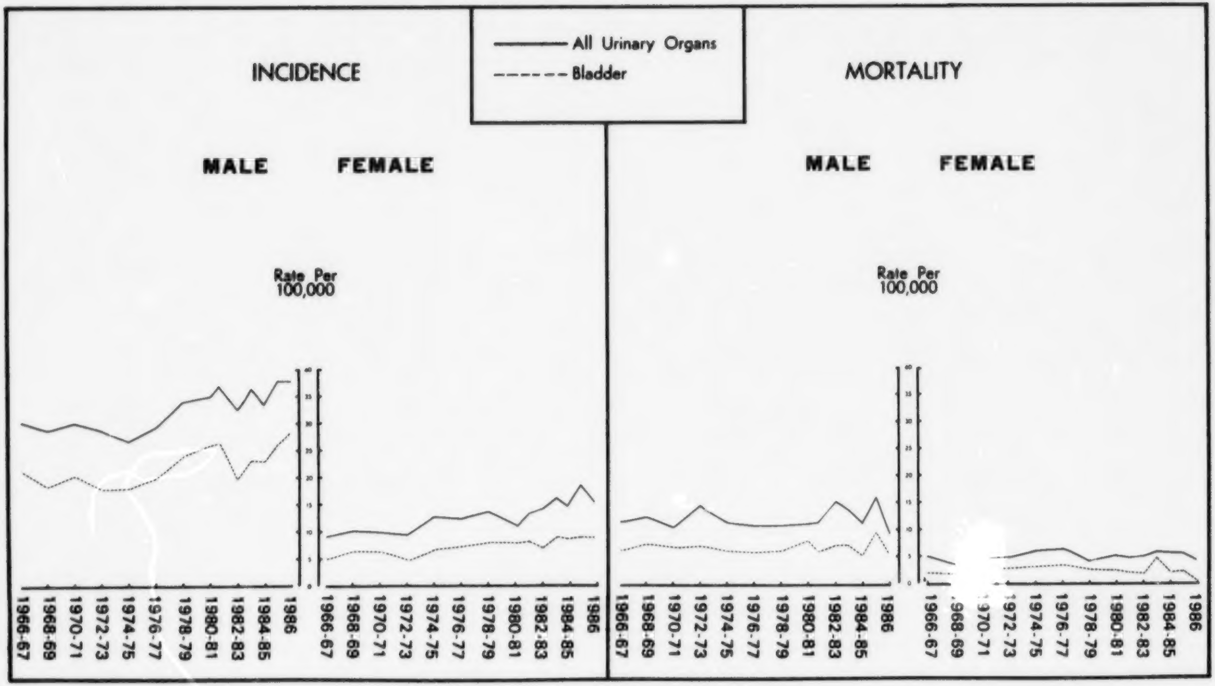
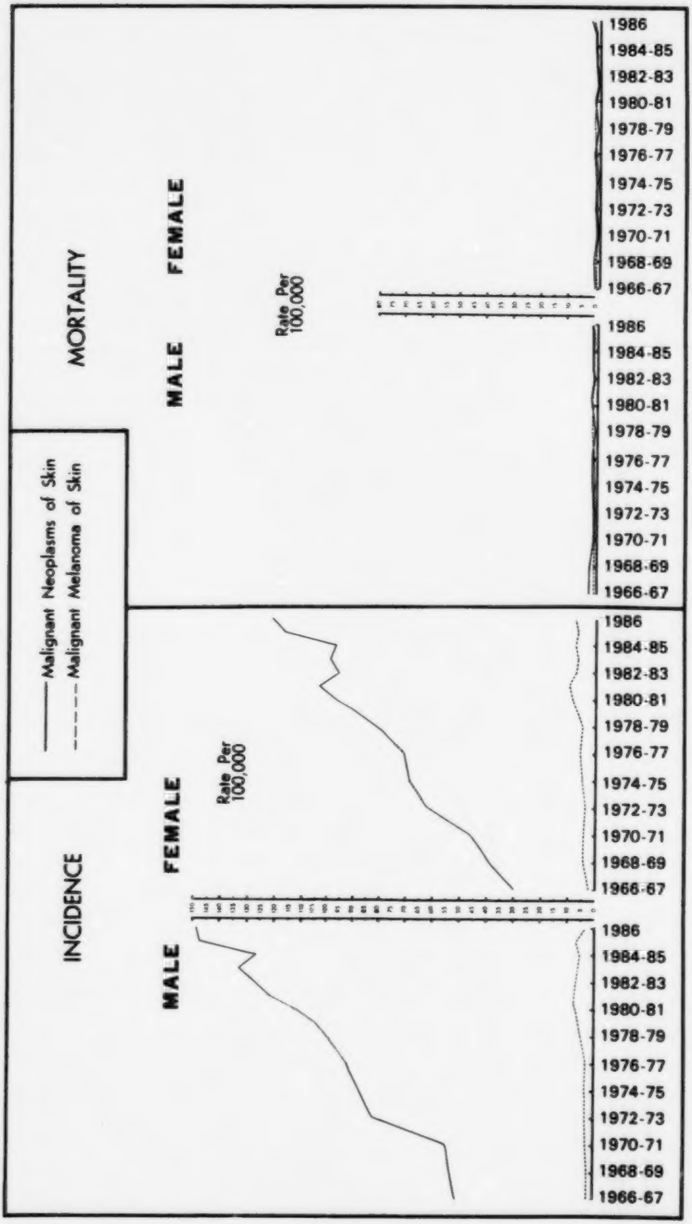


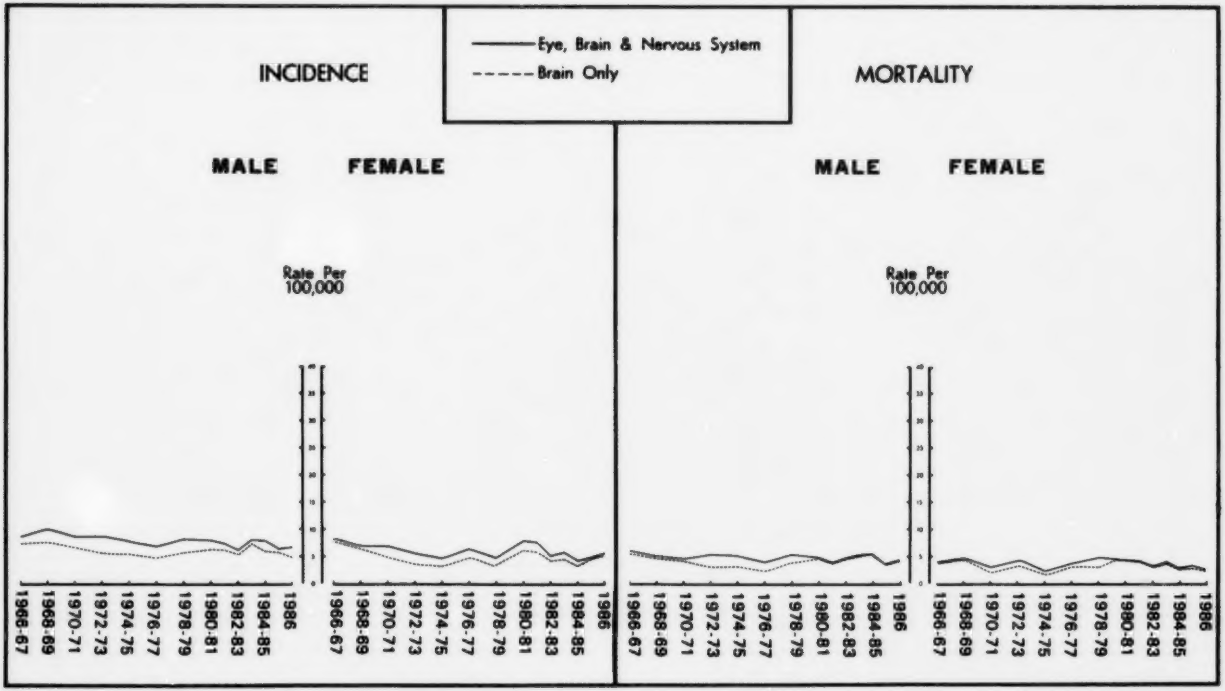
FIGURE 1 (Cont'd.)

**SKIN**



BRAIN AND NERVOUS SYSTEM

FIGURE 1 (Cont'd.)



THYROID AND ENDOCRINE GLANDS

FIGURE 1 (Cont'd.)

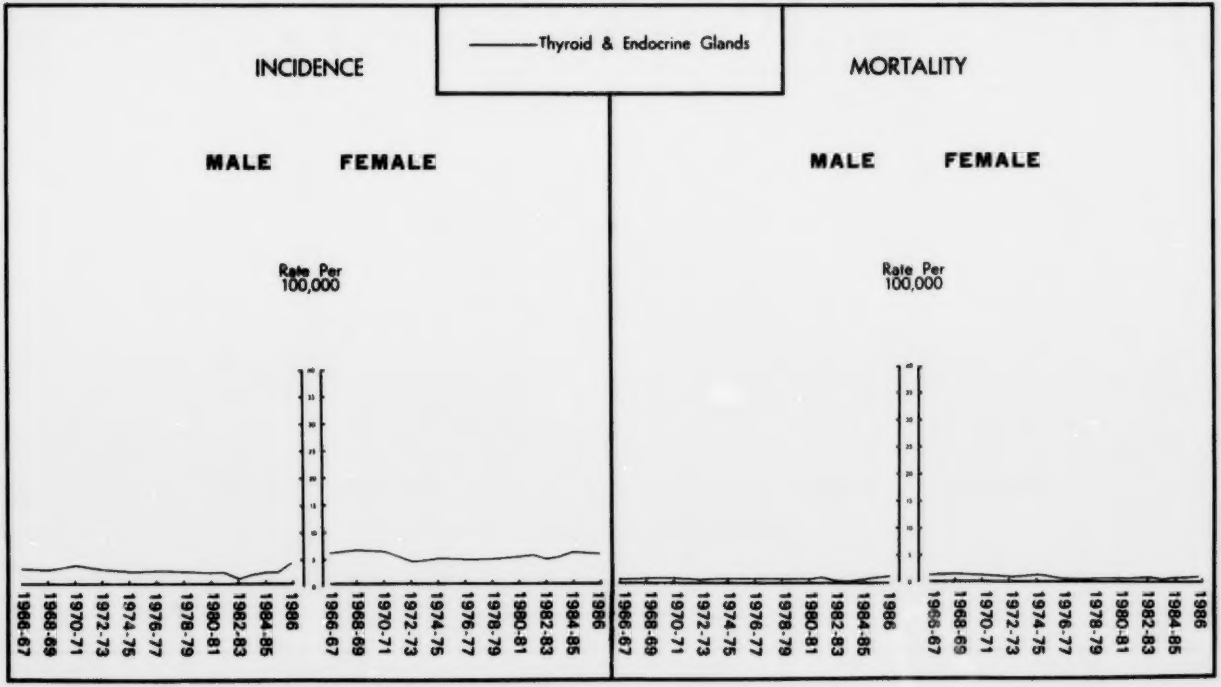


FIGURE 1 (Cont'd.)

BONES AND CONNECTIVE TISSUE

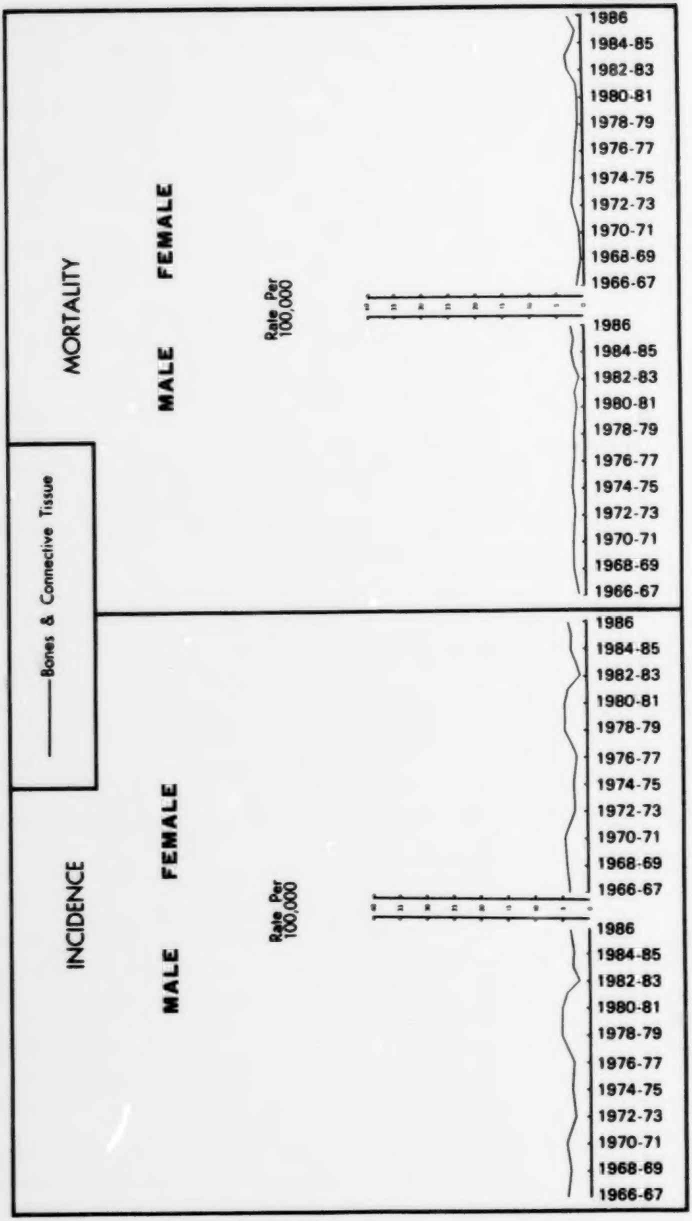
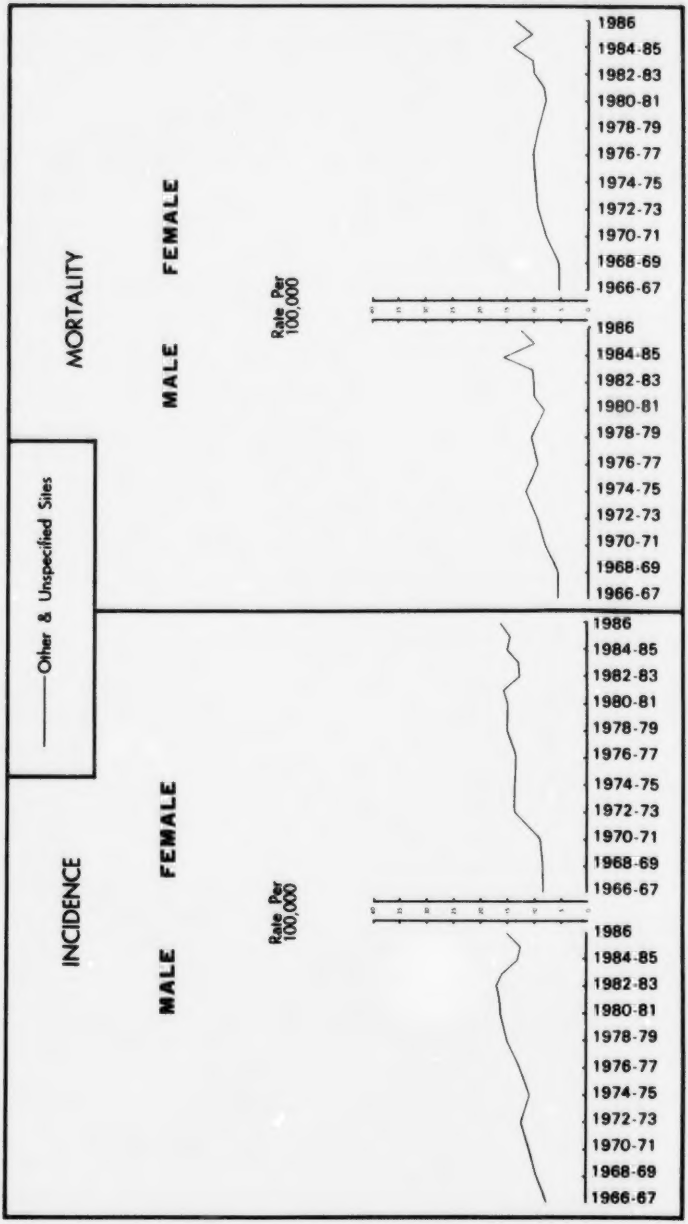


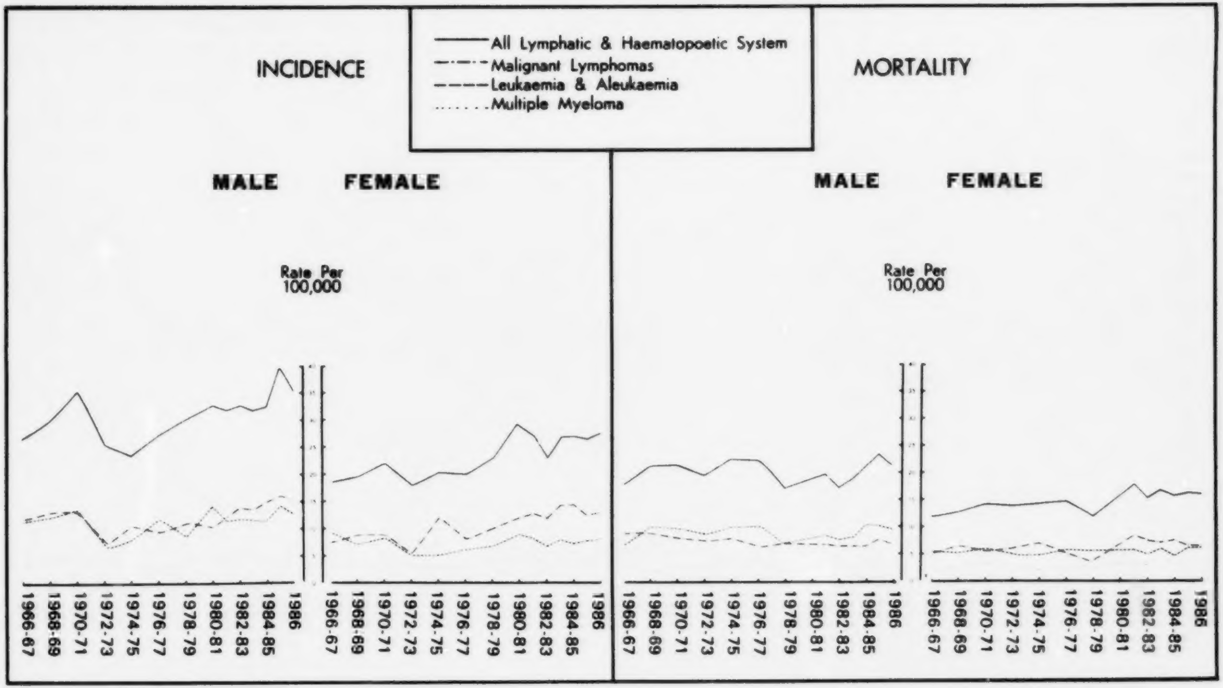
FIGURE 1 (Cont'd.)

## OTHER AND UNSPECIFIED SITES



## LYMPHATIC AND HAEMATOPOIETIC SYSTEM

**FIGURE 1** (Cont'd.)



## ALL SITES

**FIGURE 1** (Cont'd.)

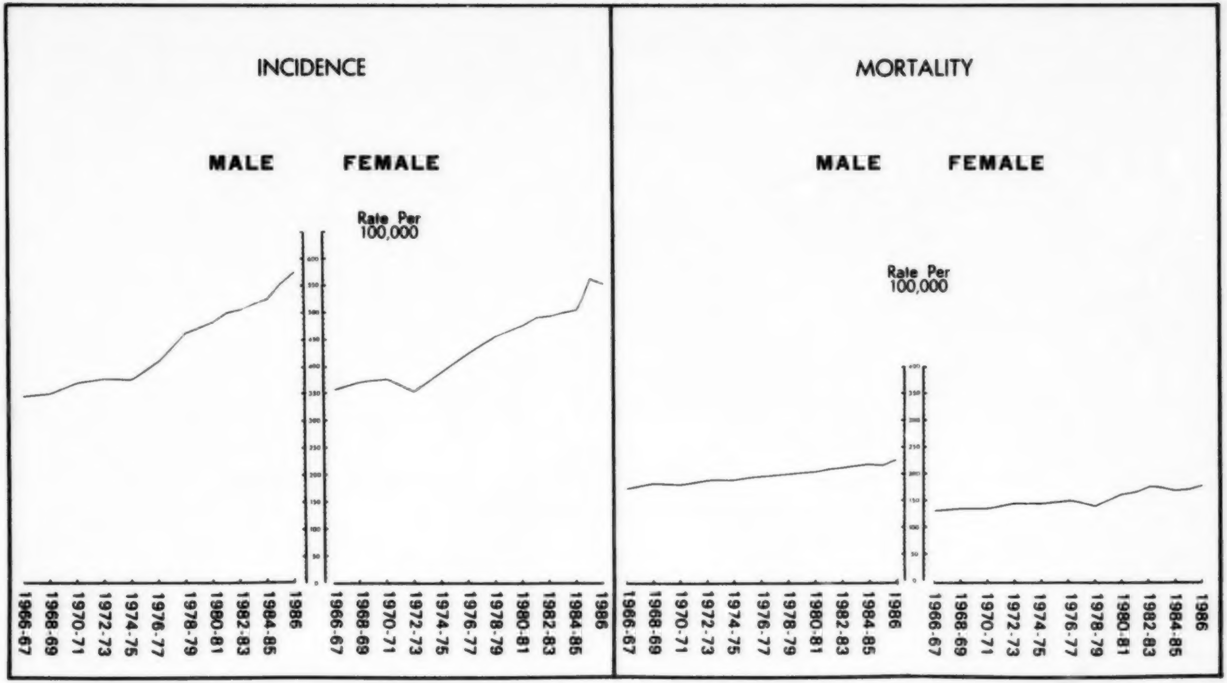


**FIGURE 2**
**TRENDS IN CANCER OF THE CERVIX UTERI IN MANITOBA 1970-1986**